# G- and K-Series

External RAID Board Controller

G5312/G7313

K5312/K7313

# User's Guide

CHAPARRAL

NETWORK STORAGE

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Document Number: 07-0033-003
This document covers G5312, G7313, K5312, and K7313.


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This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. However, if this equipment does cause interference to radio or television equipment reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between equipment and receiver.

- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/television technician for help.
- Use a shielded and properly grounded I/O cable and power cable to ensure compliance of this unit to the specified limits of the rules.

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.

### Canadian Compliance Statement

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matérial brouilleur du Canada

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# 1

# Introduction

This *User's Guide* explains how to install and use the Chaparral G- and K-Series External RAID Controllers, which are designed to be installed in a RAID enclosure and used with a host system to provide a powerful disk subsystem.

The G5312 and K5312 RAID controllers are fault-tolerant SCSI-to-SCSI RAID controllers that bridge the SCSI interface between the host system and the SCSI hard drive peripherals. They support low voltage differential (LVD) Ultra2 or single-ended Ultra SCSI buses. The G5312 and K5312 have one Ultra2 SCSI host channel and two Ultra2 SCSI disk channels. Each disk channel is a separate SCSI bus.

The G7313 and K7313 offer all of the features of the G5312 and K5312 except that they support Fibre Channel (FC) connectivity, single loop. They each have one FC host and three Ultra2 SCSI disk channels.

Administrative software is embedded in firmware; thus, the G- and K-Series requires no specific software drivers for the host operating system.

## About This Guide

This *User's Guide* describes how to install and configure your Chaparral RAID controller. It assumes that you are familiar with the basic functions of your computer system. It also assumes that you are familiar with SCSI and Fibre Channel configurations and basic network administration terminology.

## Conventions

This *Guide* uses several typographical conventions to help explain how to use the controller.

| Convention | Description |
|---|---|
| **Bold** | Words in **bold** indicate items to select such as menu items or command buttons. |
| **CTRL-R** | Keys you press simultaneously. In this example, hold down the **Ctrl** key and press the **r** key. |
|  | Notes give you important information that may affect how you decide to set up your system. |
|  | Cautions warn you about actions that may permanently delete data or cause damage to your system. |

# Product Features

The following sections describe the features of the G- and K-Series RAID controllers.

## Motherboard CPU Subsystem (G-Series)

- $Am5_x86$-133 MHz processor with internal 16 KB L1 unified code and data cache
- 8-MB zero-wait state, burst mode, extended-data out (EDO) DRAM memory (independent of disk cache)
- 1-MB nonvolatile sectored Flash event/code/configuration store memory

## Motherboard Ultra2 SCSI Channels (G-Series)

- Onboard Adaptec AIC™-789x PCI-Ultra2 SCSI interface controller ASICs
- All SCSI channels support Wide Ultra2 SCSI (80 MB/sec)
- Each SCSI channel can independently auto-sense LVD and single-ended modes and negotiate Narrow or Wide SCSI

- Supports full backward compatibility for asynchronous, fast, Ultra 1, and Ultra2 SCSI (80 MB/sec)
- SCSI terminators and termination power sources must reside in the enclosure subsystem

**Note:** There is no support for high-voltage differential (HVD) SCSI (RS-485 SCSI-3 compliant).

## Motherboard Disk Cache (G-Series)

- Adaptec AIC-2100 dual-port PCI disk cache ECC memory controller
- PCI-to-PCI Bridge providing full CPU and PCI bus concurrency
- Disk cache size modularity using standard SDRAM 168-pin ECC DIMM (16 MB to 128 MB)
- Battery backup switching regulator and control interface for disk cache memory

## Battery Interface (G-Series)

- Battery charger and battery control interface
- Integrated software-controlled battery charger, diagnostics, and periodic battery monitoring
- Battery pack connection to the motherboard or to the backplane interface
- Nickel Metal Hydride (NiMH) battery pack delivery of a minimum of 72 hours continuous backup to disk cache memory

## Hardware Configuration and Management Support (G-Series)

- Dual RS-232 serial ports
- Analog-to-digital converter for power, temperature, and enclosure monitoring
- Onboard standard PC-type lithium disk battery for continuous Real-Time Clock (RTC) power when the unit is shut down
- Dedicated channel activity LEDs, status LEDs, and alarm I/O to backplane connector interface

- General purpose I/O for enclosure-specific functions to backplane connector interface
- SAF-TE support for enclosure management.

## Onboard Connectors (G-Series)

- 2-pin fan connector (fused 12.0 V)
- 3-pin battery pack connector
- 6-pin status/fault/backup LED connector

## Daughterboard (G-Series)

The G7313 incorporates a FC daughterboard for single loop Fibre Channel connectivity.

## Motherboard CPU Subsystem (K-Series)

The K-Series motherboard that is installed in an enclosure includes the following features:

- IDT C6/C6+ Winchip, 200 MHz processor with internal 64-KB L1 cache and a 66 MHz/64-bit external bus
- 8-MB zero-wait state DRAM memory (independent of disk cache)
- 2-MB nonvolatile sectored Flash event/code/configuration store memory

## Motherboard Ultra2 SCSI Channels (K-Series)

- Three onboard Ultra2 SCSI (also known as LVD) channels
- Adaptec AIC-7890 and Adaptec AIC-7896 PCI-LVDS interface controller ASICs
- Ultra2 SCSI channel 0 can operate as an independent target or initiator (software dependent)
- All SCSI channels support Wide Ultra2 SCSI (80 MB/sec)
- Each SCSI channel can independently auto-sense LVD and single-ended modes and negotiate Narrow or Wide SCSI

- Supports full backward compatibility for asynchronous, fast, Ultra 1 (40 MB/sec), and Ultra2 SCSI (80 MB/sec)
- Onboard Ultra2 SCSI terminators supporting auto-detection and auto-configuration for LVD/SE
- Onboard termination power source circuit breakers

**Note:** There is no support for high-voltage differential (HVD) SCSI (RS-485 SCSI-3 compliant).

## Motherboard Disk Cache (K-Series)

- Adaptec AIC-2100 dual-port PCI disk cache ECC memory controller
- PCI-to-PCI Bridge providing full CPU and PCI bus concurrency
- Disk cache size modularity using standard SDRAM 168-pin ECC DIMM (16 MB to 128 MB)
- Battery backup switching regulator and control interface for controller cache memory
- Onboard battery charger and intelligent control/monitoring interface

## Integrated Battery Backup and Interface (K-Series)

- Battery charger and battery control interface
- Integrated software controlled battery charger, diagnostics, and periodic battery monitoring
- Nickel Metal Hydride (NiMH) battery pack delivery of greater than 72 hours continuous backup to controller cache memory
- Software-controlled battery charger and diagnostics

## Hardware Configuration and Management Support (K-Series)

- RS-232 serial port for configuration and troubleshooting
- Analog-to-digital converter for power, temperature, and enclosure monitoring
- Onboard standard PC-type lithium battery for continuous Real-Time Clock (RTC) power when the unit is shut down

## Onboard Connectors (K-Series)

- Qty = two 2-pin fan connector (fused 12.0 V)
- 3-pin battery pack connector
- Front panel 26-pin connector

## Fibre Channel Connection (K-Series)

The K7313 features a Fibre Channel connection for single loop Fibre Channel connectivity.

# Fibre Channel Features

- JNI FC interface controller
- 64 KB x 18 parity-protected synchronous SRAM for queuing up to 500 command blocks
- VSC7125 full-speed 10-bit transceiver, SERDES, for FC-0 interface
- 93C56 serial EEPROM, 2 Kbit in 128 x 16 organization, for storing system configuration parameters
- MIA detection circuit for optical module operation support
- LT1117, 5.0 V to 3.3 V stepdown linear voltage regulator for local 3.3 V supply
- 106.25 MHz clock generator for full-speed FC operation

# Specifications

The following sections describe the physical, electrical, environmental, and battery specifications of the G- and K-Series.

## Physical (G-Series)

Table 1-1 shows the physical specifications of the motherboard and daughterboard:

Table 1-1. Physical Specifications

| Item | Specifications |
|---|---|
| Motherboard | Form factor: 4.25 x 9.0 inch PCB outline |
| | 0.77 inch max Z-axis height without daughterboard |
| | 1.02 inch max Z-axis height single daughterboard |
| | 376-pin backplane connector receptacle |
| Daughterboard | Form factor: 4.0 x 2.19 inch max PCB board, 0.54 inch typical Z-axis height above top surface of motherboard PCB |
| | 100-pin surface mount connectors with 0.8-mm pin pitch, 7-mm connector stack height |

## Electrical (G-Series)

Table 1-2 shows the electrical specifications of the controllers:

Table 1-2. Electrical Specifications

| Item | Specifications | |
|---|---|---|
| VCC | +5.0 Vdc | G5312/G7313: |
| | | 3.0A typical Ultra2 SCSI host |
| | | 4.0A max Ultra2 SCSI host |
| | | 4.0A typical FC host |
| | | 5.0A max FC host |
| | A/D Monitoring | -3.5% to +6.5% Normal operation |
| | | 4.825 Vdc to 5.325 Vdc |
| | | >-6.5% to <+10.0% Degraded mode (warning alert) |
| | | >4.67 Vdc to <5.5 Vdc |

Table 1-2. Electrical Specifications (Continued)

| Item | Specifications | |
|---|---|---|
| | | <-6.5%, >+10.0 Controller shutdown (failure) |
| | | <4.67 Vdc, 5.5 Vdc |
| +12V | +12 Vdc | 0.6A max battery charging |
| | | 0.1 A typical normal operation |
| | | 0.2 A max normal operation |
| | A/D Monitoring | ±10.0% normal operation (10.8 Vdc to 13.2 Vdc) |
| | | >±10% Degraded mode (warning alert) (9.6 Vdc to 10.8 Vdc) |
| | | (13.2 Vdc to 14.4 Vdc) |
| | | >±20% Controller shutdown (failure) |
| | | <9.6 Vdc and >14.4 Vdc |

## Environmental (G-Series)

Table 1-3 shows the environmental specifications of the controllers:

Table 1-3. Environmental Specifications

| Item | Specifications |
|---|---|
| Reliability | MTBF (Mean Time Between Failure): 200,000 power-on hours |
| | MTTR (Mean Time To Repair): 20 minutes |
| Temperature | Internal ambient operating: |
| | $5^{o}$C to $50^{o}$C maximum with specified air flow for G5312 |
| | $5^{o}$C to $45^{o}$C maximum with specified air flow for G7313 |
| | Normal operating: $5^{o}$C to $50^{o}$C for SCSI host, $5^{o}$C to $45^{o}$C for FC host |
| | Degraded mode operating: $0^{o}$C to $5^{o}$C and $50^{o}$C to $55^{o}$C for SCSI host, |
| | $0^{o}$C to $5^{o}$C and $45^{o}$C to $55^{o}$C for FC host |
| | Non-operating: $-40^{o}$C to $+100^{o}$C |

Table 1-3. Environmental Specifications (Continued)

| Item | Specifications |
|---|---|
| Humidity | Operating: 10% to 85% non-condensing |
| | Non-operating: 5% to 90% non-condensing |
| Air flow | 10.0 cubic feet/minute (CFM[1]) minimum along longitudinal axis of controller at maximum temperature |
| Vibration | 5 Hz @ 2.0 x $10^{-7}$ PSD, 17-500 Hz @ 2.2 x $10^{-5}$ PSD (PSD = power spectral density $g^2$ /Hz) per IBM C-S 1-9711-002 |
| Shock | Vertical: 30.0 g @ 3.0 msec pulse width |
| | Horizontal: 15.0 g @ 3.0 msec pulse width per IBM C-S 1-9711-007 |

[1] Linear flow along controller Y (long) axis

## Battery (G-Series)

Table 1-4 shows the specifications of the G5312/G7313 battery available from Chaparral:

Table 1-4. Battery Specifications

| Item | Specifications |
|---|---|
| Charge time | 4 hours maximum |
| Operating range | 5°C to +40°C = 3 year life; > 40°C = 1 year life |
| Storage temperature | -20°C to +40°C |
| Storage humidity | 65% ± 20% |

A fully charged battery can provide a minimum of 72 hours backup time using all ranges of DIMM sizes. Replace batteries only with the same type as provided by the manufacturer. Dispose of batteries according to manufacturer's instructions.

If you must store the battery for a long time, you should take certain precautions to ensure the battery has sufficient charge when it is returned to service. The recommended storage temperature is between +5°C to +25°C. Avoid temperature extremes exceeding -20°C or +40°C for any extended period of time. Exposure to extreme temperatures causes the battery to discharge at a faster rate and can take longer to take a full charge when it is returned to service. A new battery or fully discharged battery can take from four to eight hours or more to fully charge.

## Physical (K-Series)

Table 1-5 shows the physical specifications of the motherboard and daughterboard.

Table 1-5. Physical Specifications

| Item | Specifications |
|---|---|
| Motherboard | Form factor: 4.95 x 7.34 inch motherboard PCB, 1.25 inch max Z-axis height |
| | AMP Z-Pack backplane mating receptacle, 235-pin connector with combined LVD, FC, RS-232 serial port, $I^2C$, general purpose I/O (GPIO), and power |
| Daughterboard | Form factor: 4.0 x 2.19 inch max PCB board, 0.54 inch typical Z-axis height above top surface of motherboard PCB. |
| | 100-pin surface mount connectors with 0.8-mm pin pitch, 7-mm connector stack height |

## Electrical (K-Series)

Table 1-6 shows the electrical specifications of the controllers.

Table 1-6. Electrical Specifications

| Item | Specifications | |
|---|---|---|
| VCC | +5.0 Vdc | 3.0 A max operating current (K5312, LVDS host) |
| | | 4.0 A max operating current (K7313, Fibre Channel host) |
| | A/D Monitoring | -3.5%, +6.5% normal operation |
| | | 4.825 Vdc to 5.325 Vdc |
| | | -5.0%, +10% degraded mode (warning alert) |
| | | 4.75 Vdc to 5.5 Vdc |
| | | <-5.0%, >+10.0% controller shutdown (failure) |
| +12V | +12.0 Vdc | 1.4 A max operating current (no battery or battery charged) |
| | | 1.8 A max operating current (battery charging) |

Table 1-6. Electrical Specifications

| Item | Specifications | |
|---|---|---|
| | A/D Monitoring | ± 8.0% normal operation<br>11.04 Vdc to 12.96 Vdc |
| | | ± 10.0% degraded mode (warning alert)<br>(10.8 Vdc) (13.2 Vdc) |
| | | >± 10.0% controller shutdown (failure)<br>14.4 Vdc |
| Battery | | 0.4 A max charging current |
| | | 0.04 A typical trickle charge current (normal operation) |
| | A/D Monitoring | Internal thermocouple in battery pack monitored |
| | | Warning issued if pack exceeds temperature range ($5^oC$ to $45^oC$) |
| | | Write back cache remains enabled during battery pack thermal warning |

## Environmental (K-Series)

Table 1-7 shows the environmental specifications of the controllers.

Table 1-7. Environmental Specifications

| Item | Specifications |
|---|---|
| Reliability | K5312 Main Board: MTBF = 200,000 hours |
| | K7313 Main and Fibre Boards: MTBF = 140,000 hours |
| | CPU Fan = 37,523, MTTF = 4.3 years |
| | Battery = 26,300, MTTF - 3.0 years |
| | Note: Battery life is probably higher based on duty cycle, battery stress is primarily during re-charge activity if battery backup is activated. |
| Temperature | $5^oC$ to $45^oC$ normal operating range with unobstructed airflow |
| | $0^oC$ to $5^oC$ and $45^oC$ to $50^oC$ degraded mode operating range |
| | $-40^oC$ to $+100^oC$ non-operating/storage (without battery pack) |
| | $5^oC$ to $25^oC$ non-operating/storage (with battery pack) |

Table 1-7. Environmental Specifications

| Item | Specifications |
|---|---|
| Humidity | 10% to 85% non-condensing operating (without battery pack) |
| | 60% to 70% non-condensing operating/non-operating (with battery pack) |
| | 5% to 90% non-condensing non-operating (without battery pack) |
| Air flow | Internally cooled, unobstructed |
| Vibration | 5 Hz @ 2.0 x $10^{-7}$ PSD, 17-500 Hz @ 2.2 x $10^{-5}$ PSD (PSD = power spectral density $g^2$ /Hz) per IBM C-S 1-9711-002 |
| Shock | Vertical: 30.0 g @ 3.0 msec pulse width |
| | Horizontal: 15.0 g @ 3.0 msec pulse width per IBM C-S 1-9711-007 |

## Battery (K-Series)

Table 1-8 shows the specifications of the battery available from Chaparral.

Table 1-8. Battery Specifications

| Item | Specifications |
|---|---|
| Charge time | 4 hours maximum |
| Operating range | 5°C to +40°C = 3 year life; > 40°C = 1 year life |
| Storage temperature | 5°C to 25°C |
| Storage humidity | 65% ± 5% |

**Note:** Outside these limits the battery life will be diminished.

If you must store the battery for a long time, you should take certain precautions to ensure the battery has sufficient charge when you return it to service. The recommended storage temperature is between +5°C to +25°C. Avoid temperature extremes exceeding -20°C or +40°C for any extended period of time. Exposure to extreme temperatures causes the battery to discharge at a faster rate and can take longer to take a full charge when it is returned to service. A new battery or fully discharged battery can take from four to eight hours or more to fully charge.

# Reference Documents

## External Documents

- Adaptec's AIC-7890/91 and AIC-7896, PCI Bus Master Single-chip LVDS Ultra II ASIC Data Book
- Adaptec's AIC-1160, PCI Bus Master Single-chip Fibre Channel Data Book
- SCSI-2 and SCSI-3 Specification - ANSI standard documents
- Fibre Channel Physical and Signaling Interface (FC-PH) - ANSI standard document

## Chaparral Documents

- Chaparral CAPI Functional Specification
- Chaparral K5312/K7313 Board-Only Design-In Handbook
- G5312/G7313 External Raid Controller Design-In Handbook
- Multi-LUN SAF-TE Environmental Processor Design

# 2

# Hardware Installation

This chapter explains how to connect the controller in your RAID enclosure to your network and host computer.

## Connecting the Controller

Your controller is already installed in an enclosure. Before you configure the controller and create arrays, you must connect the controller, which has two types of data connections:

- SCSI channel (G5312 and K5312)—permitting connection to a server (host).
- Fibre Channel (G7313 and K7313)—permitting connection to other FC devices, typically through an arbitrated loop or SAN with fabric.
- RS-232 serial port—for configuration and management of the controller.

### Connecting to the SCSI Port

You can connect the controller (G5312 and K5312) to a SCSI port. Refer to your enclosure documentation for the type of connector required.

**To connect to the SCSI port:**

1. Be sure the enclosure is turned off.
2. Connect one end of the SCSI cable to the SCSI port on the enclosure.
3. Connect the other end of the SCSI cable to a server's SCSI port.

### Connecting to the Fibre Channel Port

You can connect the controller (G7313 and K7313) to an FC HBA or to an FC switch or hub. You must use proper FC components. Refer to your enclosure documentation for the type of connector required.

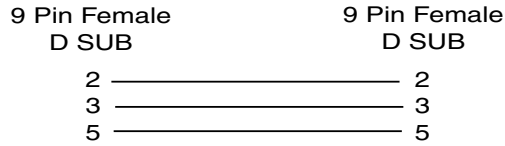
**To connect to the Fibre Channel port:**

1. Be sure the enclosure power is turned off.
2. Connect one end of the Fibre Channel cable to the FC port on the enclosure.
3. Connect the other end of the Fibre Channel cable to a server's HBA or to an arbitrated loop hub or fabric switch.
4. Turn power on and begin configuration.

## Connecting to the RS-232 Port

You use the RS-232 port to update the firmware, configure, and monitor the controller using a VT-100/ANSI computer with a terminal emulator.

Refer to your enclosure documentation for information about the correct type of cable to use. Use a 9-pin straight-through cable. A null modem cable does not work.




Configure the RS-232 port in your terminal emulator software using the following settings:

- Baud rate: 9600, 19200, 38400, 57600, or 115200; 115200 best for downloading firmware upgrades
- Data Bits: 8
- Stop Bits: 1
- Parity: None
- Flow Control: None or XON/XOFF.

**To connect to the RS-232 port:**

1. Be sure the enclosure power is turned off.
2. Using a straight-through serial cable, connect one end of the cable to the serial port on the enclosure.
3. Connect the other end of the serial cable to the serial port on the computer that will monitor and configure the controller.
4. Turn power on and begin configuration.

# 3

# Accessing the Disk Array Administrator Software

You can display and change a variety of settings using the Disk Array Administrator software. Using the Disk Array Administrator, you can:

- Create and mange arrays (see Chapter 4, *Creating and Managing Arrays*)
- Monitor system status (see Chapter 5, *Monitoring System Status*)
- Manage spares (see Chapter 6, *Managing Spares*)
- Configure the controller (see Chapter 7, *Configuring the Controller*)
- Manage disk drives and enclosures (see Chapter 8, *Managing Disk Drives and Enclosures*)

You can access the Disk Array Administrator software using the RS-232 serial port connection on the controller. You must connect a computer with terminal emulator software, such as HyperTerminal, to the serial port according to *Connecting to the RS-232 Port* on page 2-2.

## Accessing the Disk Array Administrator Using the RS-232 Serial Port

You can access the Disk Array Administrator software using the RS-232 serial port.

You must use a straight-through serial cable. You cannot use a null modem cable.

Configure the RS-232 port in your terminal emulator software using the following settings:

| Setting | Value |
|---|---|
| Terminal Emulation | VT-100 or ANSI (for color support) |
| Font | Terminal |

| Setting | Value |
|---|---|
| Translations | None |
| Columns | 80 |

Set the communications parameters for the terminal program as follows:

| Setting | Value |
|---|---|
| Baud rate | 115,200 |
| Data bits | 8 |
| Stop bits | 1 |
| Parity | None |
| Flow Control | Software (XON/XOFF) |
| Connector | COM1 (typically) |

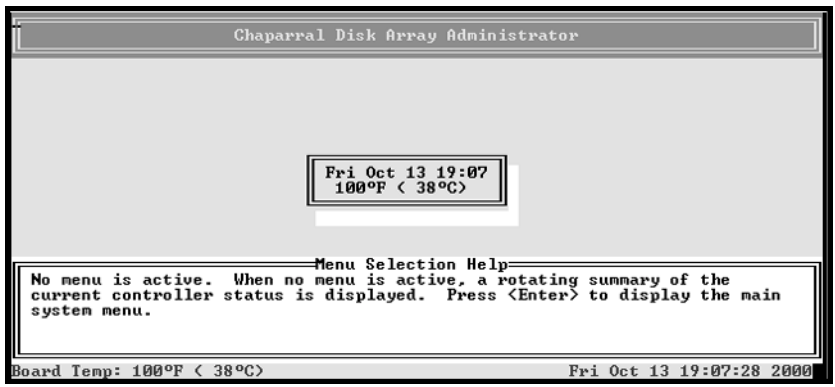
**To access the Disk Array Administrator software using the RS-232 serial port:**

1. From the computer connected to the controller, start your terminal emulation software.

   Be sure that your terminal emulation software is set to use the correct COM port on your computer. See *Terminal Emulator and COM Port Problems* on page 9-1 for more details on how the controller can auto-detect the baud rate.

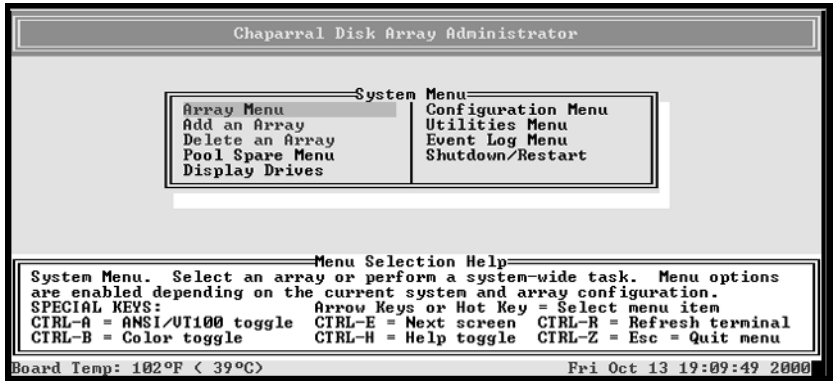
2. Press **CTRL-R**.

   The initial Chaparral Disk Array Administrator screen displays.



**3** Press **Enter**.

The System Menu displays.




You can now perform all of the functions described in following chapters. All steps start from the System Menu.

If an alarm condition has occurred, you will see a message about the problem. This message will also be stored in the event log.

# Navigating the Disk Array Administrator Software

You can navigate the Disk Array Administrator software using your keyboard. Table 3-1 below describes the primary navigation and selection methods:

Table 3-1. Disk Array Administrator navigation

| To | Do this |
|---|---|
| Select a menu item | Press the ↑ and ↓ and press **Enter**.<br>or<br>Press the letter that is a different color (or highlighted) in a menu item (hot key). |
| Return to the previous menu or screen without saving your changes | Press **Esc, CTRL+Z,** or ←. |
| Scroll through the available choices for a setting | Press the ↑ and ↓. |

**Note:** After four minutes of inactivity, the Disk Array Administrator software times out and returns to the initial screen.

## Changing the Screen Display

After you have accessed the Disk Array Administrator software, you can change the screen display using a combination of keystrokes, as shown on the System Menu. Table 3-2 lists the keystrokes required to change various screen displays.

Table 3-2. Changing screen displays

| Select | Function |
|---|---|
| Ctrl-A | Toggles between ANSI and VT100 character sets (use VT100 for legacy systems) |
| Ctrl-B | Toggles between black and white and color screen |
| Ctrl-E | Toggles between the event log, hardware information, and configuration information screens |
| Ctrl-H | Displays Help screen |
| Ctrl-R | Refreshes screen |
| Ctrl-Z, Esc, or ← | Escapes or quits menu |

## Disk Array Administrator Menu Tree

Figure 3-1 on page 3-5 and Figure 3-2 on page 3-6 describe the complete Disk Array Administrator menu hierarchy. In the Disk Array Administrator, menu options that are not accessible appear gray. For example, the Array Menu is not accessible unless one or more arrays exist.

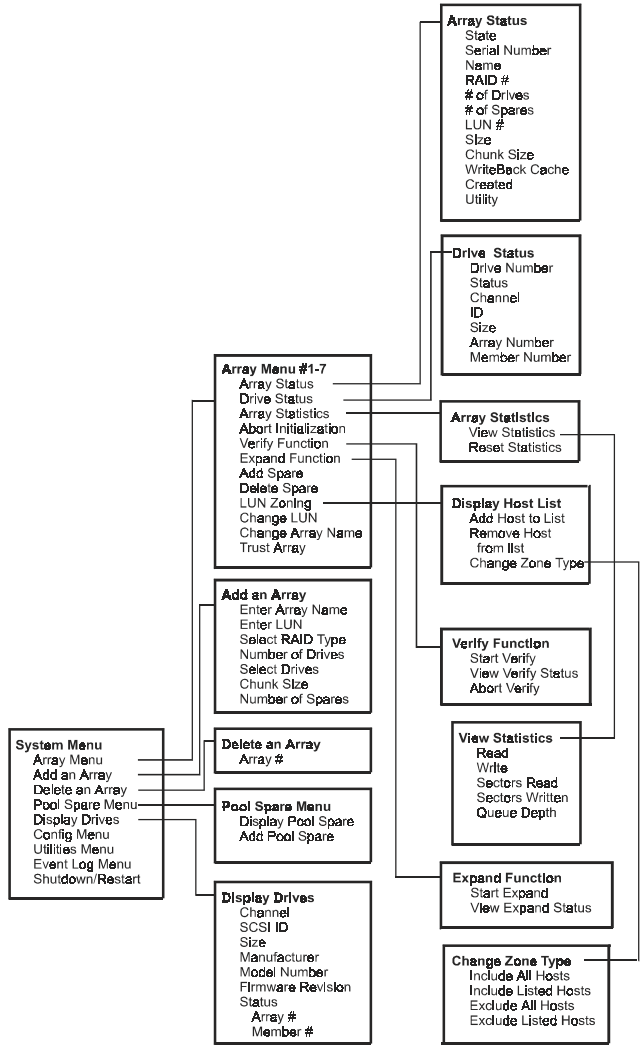



Figure 3-1. Menu tree

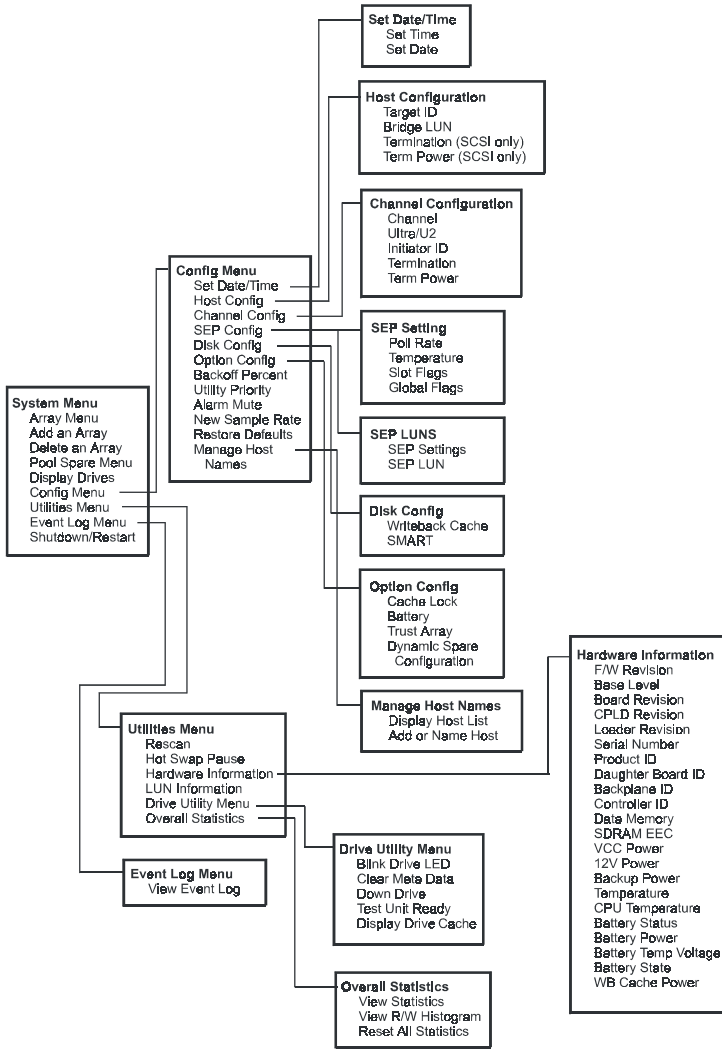



Figure 3-2. Menu tree (continued)

# 4

# Creating and Managing Arrays

Using the Disk Array Administrator, you can create and manage arrays. You can perform the following array-related functions:

- Create arrays (see page 4-1)
- View array and drive status (see page 4-8)
- Stop the initialization process (see page 4-14)
- Verify an array (see page 4-15)
- Reconstruct an array (see page 4-17)
- Expand array capacity (see page 4-18)
- Change the array Logical Unit Number (LUN) (see page 4-21)
- Change the array name (see page 4-22)
- Trust an array (see page 4-22)
- Delete an array (see page 4-24)

## Creating Arrays

You can create an array anytime. The following table describes the drive requirements for each RAID level.

Table 4-1. Drive requirements by array type

| RAID Level | Minimum No. of Drives | Maximum No. of Drives |
|---|---|---|
| Volume Set | 1 | 1 |
| 0 | 2 | 16 |
| 3 | 3 | 16 |
| 4 | 3 | 16 |

Table 4-1. Drive requirements by array type (Continued)

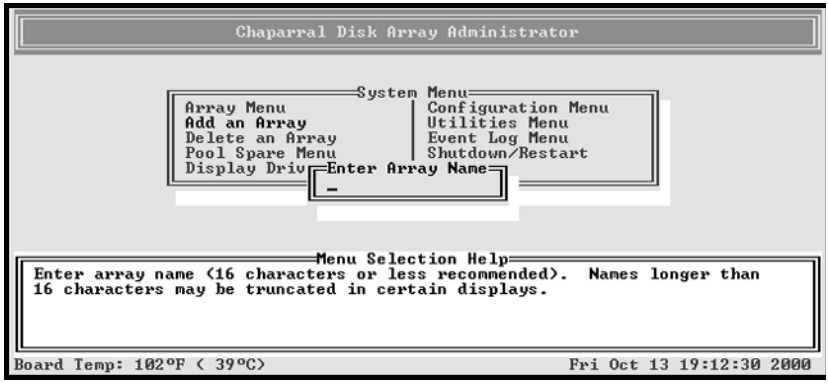
| RAID Level | Minimum No. of Drives | Maximum No. of Drives |
|---|---|---|
| 5 | 3 | 16 |
| 50 | 6 | 16 |
| Mirrored | 2 | 16 |

**Note:** Before you create more than one array, you must be sure that your host operating system supports multiple Logical Unit Numbers (LUNs). Most operating systems do, or have an option you can enable to support multiple LUNs. If your operating system does not support multiple LUNs, the host will only be able to see one array.

**To create an array:**

1 From the System Menu, select **Add an Array** and press **Enter**.

The Enter Array Name screen displays.

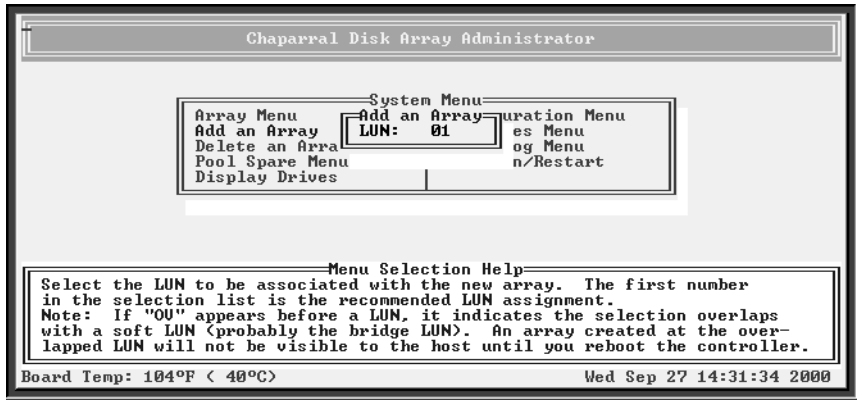



2 Enter a name for the array and press **Enter**.

You can use up to 35 characters. You can include any characters in the name, including spaces.

If you do not want to name the array, you can just press **Enter**. You can add or change the name later.

The LUN screen displays.




**3** Select the LUN for the array and press **Enter**.

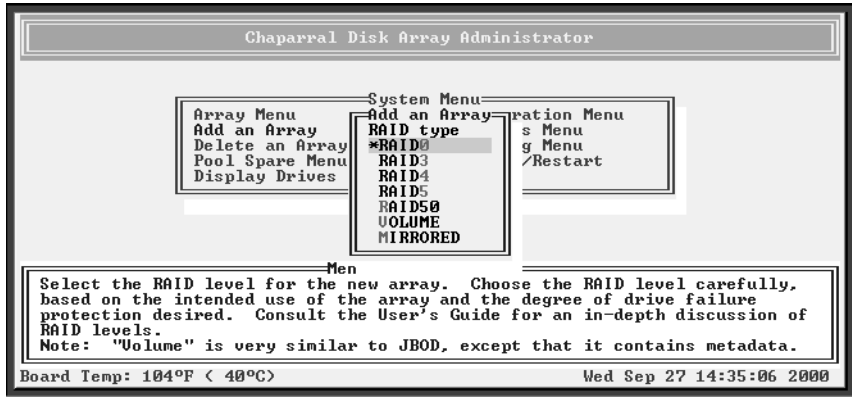
The LUN that displays is the suggested default LUN assignment.

If the letters OV appear before a LUN, it indicates that the selection overlaps with a soft LUN, probably the controller or SAF-TE Environmental Processor (SEP) LUN. You can create an array at an overlapped LUN, but it is not visible to the host system until you reboot the controller.

**Note:** Most Unix, Linux, and Macintosh operating systems require the controller LUN be a higher value than all array LUNs. Before creating your first array, change the controller LUN to a higher value or choose NONE (best choice) if you are not using CAPI to manage the arrays. This allows your first array to be seen at LUN 0.

The system warns you about the LUN for UNIX and Macintosh, as above, the first time you create an array. Press **Enter** and the system asks if you want to be warned again. Select **No** to avoid receiving this warning again, otherwise select **Yes** to be warned the next time you create an array.

The RAID Type screen displays.

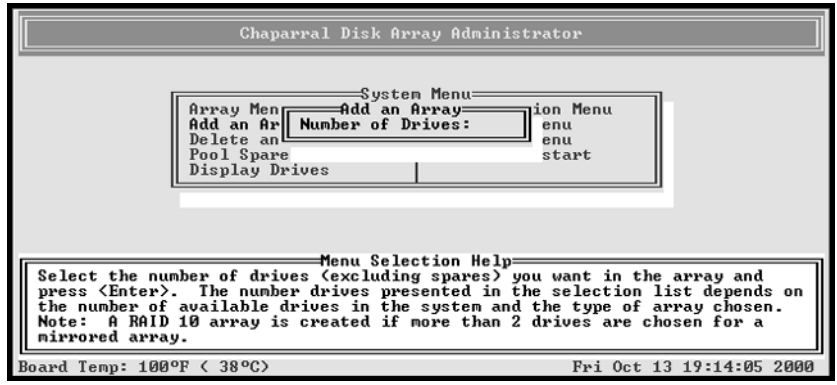



**4** Select the array type: **RAID0**, **RAID3, RAID4, RAID5, RAID50, VOLUME** (a single drive similar to just a bunch of disks (JBOD) except that it includes metadata), or **MIRRORED** and press **Enter**.

**Note:** A RAID 10 array is created when there are more than two drives in a mirrored array.

See Appendix A, *Array Basics* for more information.

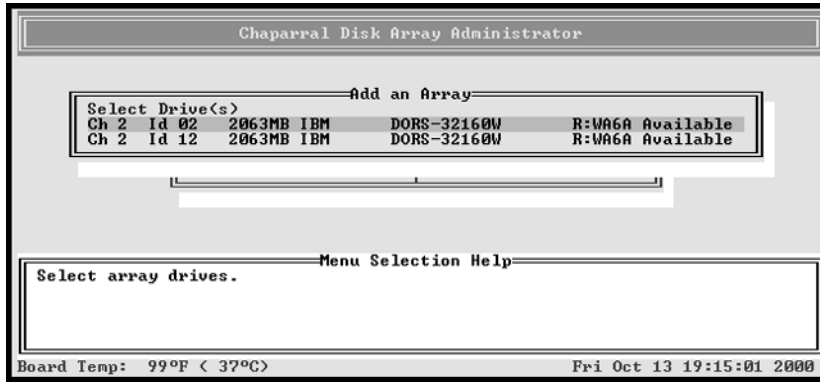
The Number of Drives screen displays.



**5** Enter the number of drives (excluding spares) you want in the array and press **Enter**.

The Select Drives screen displays with a list of all available drives, including the following information about each drive:

- Channel
- SCSI ID
- Drive capacity
- Drive manufacturer
- Drive model number
- Drive firmware revision
- Drive state




**6** Select the drives you want to use for the array and press **Enter**.

You select a drive by highlighting it and pressing **Enter**. Each selected drive turns gray in the drive list. After you press **Enter** for the number of drives you entered previously, the system automatically goes to the next screen. To skip a drive, use the ↑ or ↓ keys.

If the array is mirrored, RAID 3, RAID 4, RAID 5, or RAID 50 *and* you have one or more drives left, the Number of Spares screen displays.

**7** If the Number of Spares screen displays, enter the number of spares you want to add and press **Enter**.

This creates dedicated spares that can only be used by this array. A dedicated spare drive will not be available for any other use. For more information about spares, see Chapter 6, *Managing Spares*.

If you do not want a spare, enter 0.

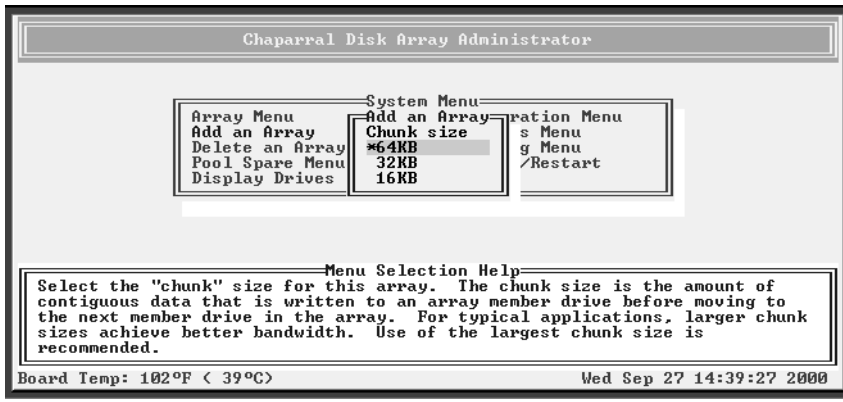
The Select Drives screen displays.

**8** If the Select Drives screens displays, select the drive you want to use as a dedicated spare and press **Enter**.

Only available drives, that is, drives that are not members of an array and are not assigned as a dedicated or pool spares, display. You can delete a dedicated spare from the array at any time. For more information see, *Deleting a Dedicated Spare* on page 6-3.

You select a drive by highlighting it and pressing **Enter**. Each selected drive turns gray in the drive list. After you press **Enter** for the number of drives you entered previously, the system automatically goes to the next screen. To skip a drive, use the ↑ or ↓ keys.

If the array you are creating is a RAID 3, RAID 4, RAID 5, or RAID 50, the Chunk Size screen displays.




**9** If the Chunk Size screen displays, select the chunk size and press **Enter**.

The chunk size is the amount of contiguous data that is written to an array member before moving to the next member of the array. To determine the

appropriate chunk size, refer to your operating system documentation. For example, the default chunk size for Windows NT and many other operating systems is 64 KB. If you are using the array for a database with very small records, you may want to use a smaller chunk size.

The system confirms that you want to create the array.

**10** Select **Yes** and press **Enter**.

A message notifies you that the array is being created and shows the progress of the initialization process. The array initialization process takes from several minutes to more than an hour depending on the array type (volume, RAID 0, and RAID 1 are the fastest), array size, drive speed, and other processes running on the controller.

You can press **Esc** to return the Disk Array Administrator menus and perform other functions. To check the progress of the array initialization, select **Array Menu** from the System Menu. The status of the initialization displays in the list of arrays.

If you find that you need to change the disks or some other array configuration, you can stop the array initialization process. See *Stopping the Array Initialization Process* on page 4-14.

**Note:** Most operating systems, such as Windows NT 4.0, require you to reboot the host system to see the new array. NetWare v3.12 and higher can recognize new devices by typing the command SCAN FOR NEW DEVICES at the console prompt. Other operating systems might have similar features.

# Managing Arrays

The Disk Array Administrator software lets you manage your arrays in a variety of ways. You can:

- View array and drive status (see page 4-8)
- Stop the initialization process (see page 4-14)
- Verify an array (see page 4-15)
- Reconstruct an array (see page 4-17)
- Expand array capacity (see page 4-18)
- Change the array LUN (see page 4-21)
- Change the array name (see page 4-22)
- Trust an array (see page 4-22)
- Delete an array (see page 4-24)

## Viewing Array Status

You can view the status of an array, including the following information:

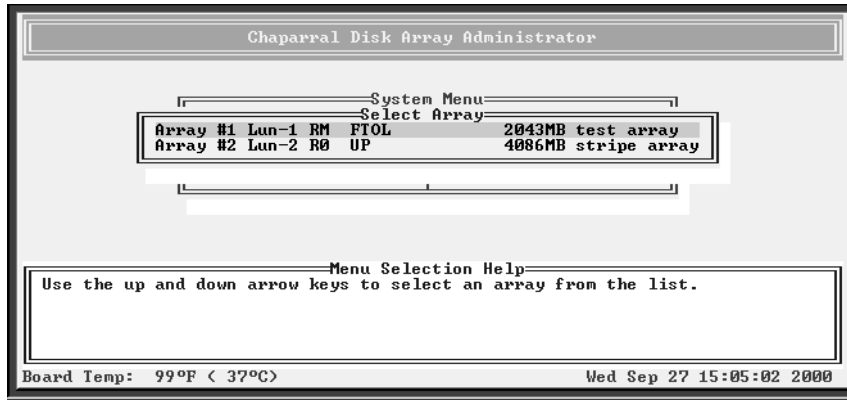
- State—Online, Offline, Critical, or Fault-tolerant.
- Name—The name given to the array.
- RAID—RAID type (0, 3, 4, 5, 50, Volume, or Mirrored). The term "mirrored" is used for both RAID 1 and RAID 10 arrays.
- # of Drives—Number of drives in the array when fault-tolerant. For example, if you create a three-drive RAID-5 array and lose one drive, the number will still display 3.
- # of Spares—Number of spare drives dedicated to this array.
- LUN #—LUN presented to the host system.
- Size—Size of the entire array (expressed in MB or GB for arrays larger than 10 GB).
- Chunk size—The array's chunk size.

- WBcache—Status of the write-back cache (enabled or disabled) for this array.
- Created—Date the array was created.
- Utility—Utility running (None, Verify, Reconstruct, Expand, or Initialize).

**To view the status of an array:**

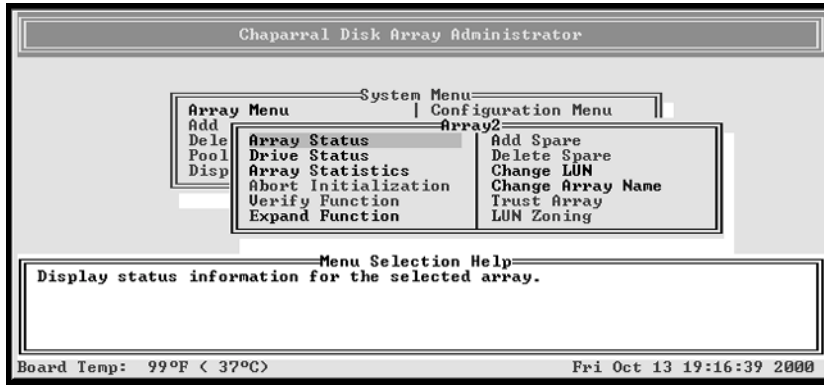
1 From the System Menu, select **Array Menu** and press **Enter**.

The Select Array screen displays with a list of existing arrays.



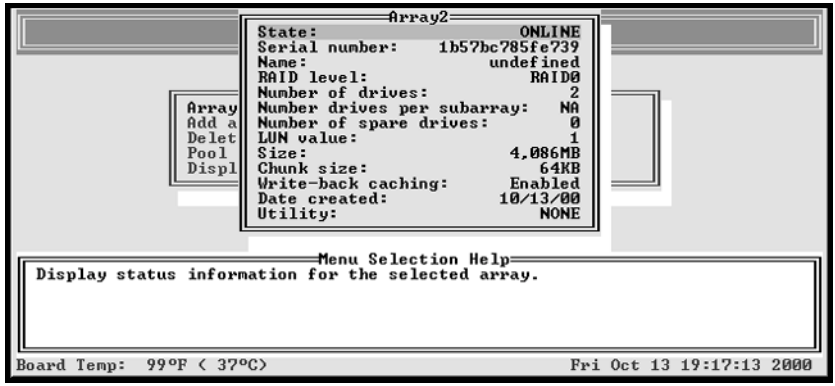

2 Select the array you want and press **Enter**.

The Array Menu screen displays.



3 Select **Array Status** and press **Enter**.

The status screen displays showing the status of the array you selected.




4 Press **Esc** to return to the Array Menu.

## Viewing Array Statistics

You can view the current array statistics. The following statistics are available:

- Read—Total number of host read requests directed to the array
- Write—Total number of host write requests directed to the array
- SecRd—Total number of sectors read from the array
- SecWt—Total number of sectors written to the array
- Queue Depth—Current number of commands from the host that are queued up
- I/O Size—Last host I/O block size request in 512-byte sectors

Similar statistics are also available on an aggregate basis for all array LUNs. For more information, see *Displaying Overall Statistics* on page 5-11.

**To view the array statistics:**

1 From the System Menu, select **Array Menu** and press **Enter**.

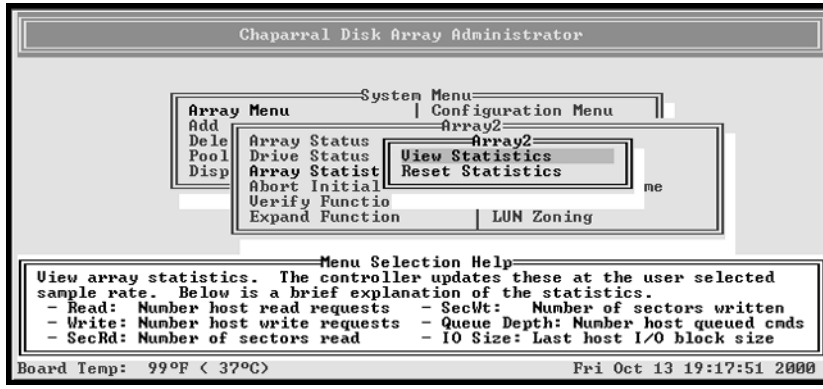
The Select Array screen displays with a list of existing arrays.

**2** Select the array you want and press **Enter**.

The Array Menu screen displays.

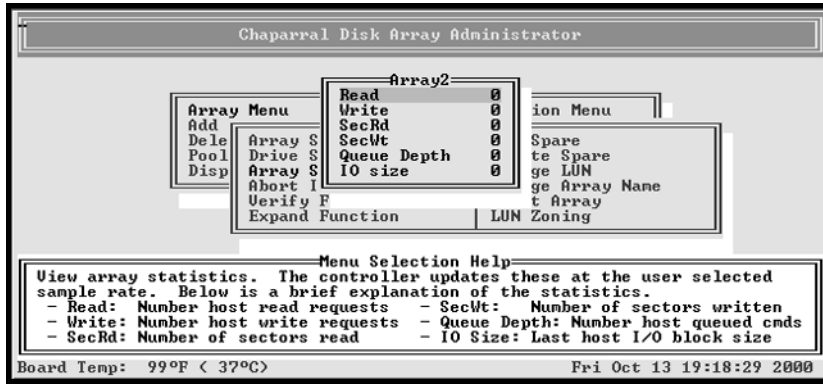
**3** Select **Array Statistics** and press **Enter**.

The statistics menu screen displays.




**4** Select **View Statistics** and press **Enter**.

The statistics screen displays showing the statistics of the array you selected.




**5** Press **Esc** to return to the statistics menu.

## Resetting Array Statistics

You can reset the follow array statistics to zero:

- Read
- Write
- SecRd
- SecWt
- I/O Size

**Note:** Resetting statistics here also resets the statistics for this array that are included in the aggregate statistics. See *Displaying Overall Statistics* on page 5-11.

You may want to reset the statistics if you are monitoring performance or doing benchmark testing. You may also want to reset statistics when you change how you are using the array.

**Note:** You cannot reset the queue depth value. It always reflects the current I/O queue depth.

**To reset array statistics:**

1. From the System Menu, select **Array Menu** and press **Enter**.

   The Select Array screen displays with a list of existing arrays.

2. Select the array you want and press **Enter**.

   The Array Menu screen displays.

3. Select **Array Statistics** and press **Enter**.

   The statistics menu screen displays.

4. Select **Reset Statistics** and press **Enter**.

   The system confirms that you want to make the change.

5. Select **Yes** and press **Enter**.

   The system confirms that the statistics have been cleared and returns to the statistics menu.

## Viewing Drive Status

You can view the status of the drives in an array, including the following information:

- Drive number—This drive's sequential position in the controller's drive list
- Drive status—Whether the drive is up or down
- Channel number—Back-end disk bus number
- Target ID
- Size—Size of the drive in MB
- Status—If part of an array, this displays the array name and member number. If a spare, this displays the type of spare. If unused, displays Available. If drive was part of an array that no longer exists, displays Leftover.

**Note:** If a drive has failed or malfunctioned, it may not be listed.

**To view drive status:**

1. From the System Menu, select **Array Menu** and press **Enter**.

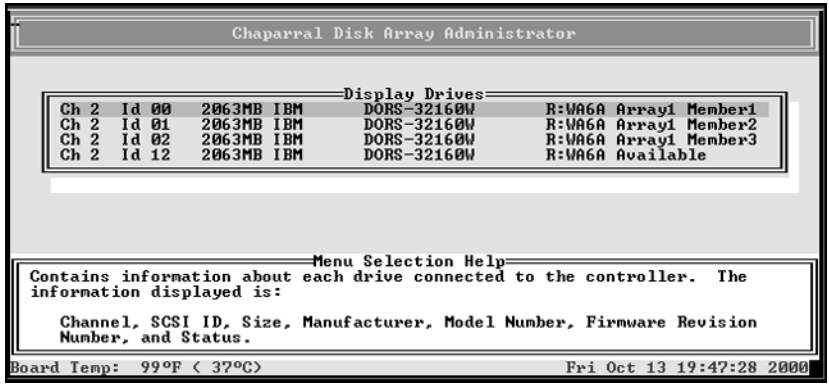
   The Select Array screen displays with a list of existing arrays.

2. Select the array you want and press **Enter**.

   The Array Menu screen displays.

3. Select **Drive Status** and press **Enter**.

The drive status screen displays showing the drives that are members of the array and that are assigned as dedicated spares.




Use the ↑ or ↓ arrow keys to scroll through the drives. These are the drives that are currently members of the array.

4 Press **Esc** to return to the Array Menu.

## Stopping the Array Initialization Process

If you find that you need to change the disks or some other array configuration, you can stop the array initialization process.

After you stop the process, the array is marked as offline and cannot be used. You must delete the array before you can use the drives in another array.

**To stop the array initialization process:**

1 From the System Menu, select **Array Menu** and press **Enter**.

The Select Array screen displays with a list of existing arrays.

2 Select the array you want and press **Enter**.

The Array Menu screen displays.

3 Select **Abort Initialization** and press **Enter**.

The system confirms that you want to stop the initialization process.

4 Select **Yes** and press **Enter**.

## Verifying an Array

The Verify function allows you to verify the data on the specified array (RAID 3, RAID 4, RAID 5, RAID 50, and mirrored arrays only):

- RAID 3, RAID 4, RAID 5, and RAID 50—Verifies all parity blocks in the selected array and corrects any bad parity.
- Mirrored—Compares the primary and secondary drives. If a mismatch occurs, the primary is copied to the secondary.

You may want to verify an array when you suspect there is a problem.

**To verify an array:**

1. From the System Menu, select **Array Menu** and press **Enter**.

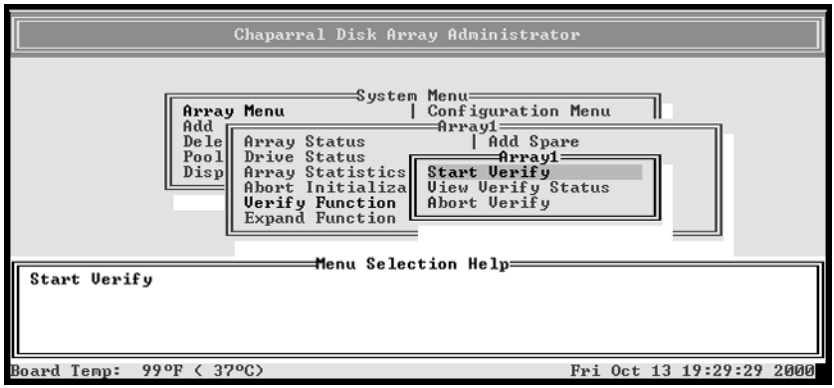
   The Select Array screen displays with a list of existing arrays.

2. Select the array you want and press **Enter**.

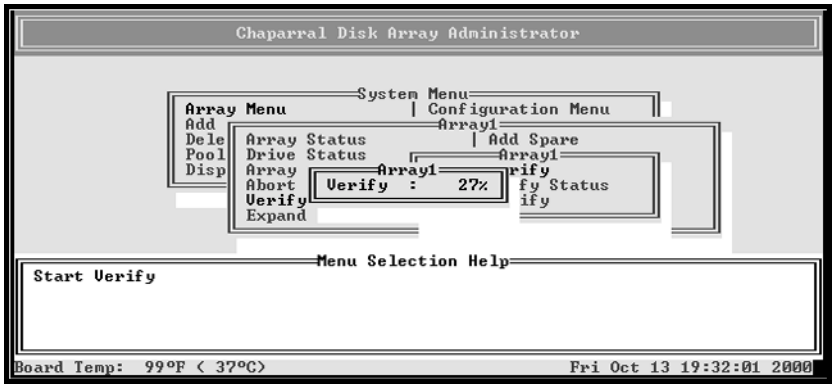
   The Array Menu screen displays.

3. Select **Verify Function** and press **Enter**.

   The verify menu displays.



4 Select **Start Verify** and press **Enter**.




Verification begins and the percentage of verification completed displays. You can continue to use the array during verification.

To return to the verification menu, press **Esc**. To check the progress of the array verification, you can use the verification status described below or select **Array Menu** from the System Menu. The status of the verification displays in the list of arrays.

## Viewing Verification Status

You can view the status of the verification process while it is running.

**To view verification status:**

1 From the System Menu, select **Array Menu** and press **Enter**.

The Select Array screen displays with a list of existing arrays.

2 Select the array you want and press **Enter**.

The Array Menu screen displays.

3 Select **Verify Function** and press **Enter**.

The verify menu displays.

4 Select **View Verify Status** and press **Enter**.

The Verify Status screen displays.

5 Press **Esc** to return to the verify menu.

### Stopping the Verification

You can stop the verification process. Normally, you want to let the verification finish, though stopping it does *not* cause any damage to your data. You may want to stop the verification if you want improve performance of the controller for another application.

**To stop the verification process:**

1. From the System Menu, select **Array Menu** and press **Enter**.

   The Select Array screen displays with a list of existing arrays.

2. Select the array you want and press **Enter**.

   The Array Menu screen displays.

3. Select **Verify Function** and press **Enter**.

   The verify menu displays.

4. Select **Abort Verify** and press **Enter**.

   The system confirms that you want to stop the verification process.

5. Select **Yes** and press **Enter**.

## Reconstructing an Array

The controller automatically reconstructs redundant arrays (RAID 3, RAID 4, RAID 5, RAID 50, and mirrored) if an array becomes critical and a properly sized spare drive is available. An array becomes critical when one or more member drives fails.

If a reconstruct does not start automatically, it means that no valid spares are available. To start a reconstruct, replace the failed drive, and then add it as a spare (see *Adding a Dedicated Spare* on page 6-2, and *Enabling Dynamic Spares* on page 6-3) or as a pool spare (see *Adding a Spare to the Spare Pool* on page 6-5). Remember that any pool spares added might be used by any critical array, not necessarily the array you want.

## Expanding Array Capacity

You can expand array capacity without stopping I/O activity, so you can continue using the array while the expansion process runs. You can only expand one array at a time.

**Note:** Expanding an array here does not change the size of the host operating system partitions that reside on the array, because our controller is working at the block level not the file system level of the operating system. To use the new space, you must create a new partition using the newly added space or use a third party application specific to the operating system to change the partition size.

How you create a new partition or resize an existing one depends upon the operating system. Most operating systems cannot resize an existing partition. Refer to your operating system documentation.

The number of drives you can add to an array depends upon the RAID level as shown below. You also cannot exceed the maximum number of drives for each RAID level. See *Creating Arrays* on page 4-1.

Table 4-2. Drive additions by RAID level

| RAID Level | Number of Drives You Can Add |
|---|---|
| RAID 0 | 1 to 4 |
| RAID 1 (mirrored) | Cannot expand |
| Volume Set | Cannot expand |
| RAID 10 | 2 or 4 |
| RAID 3, 4, or 5 | 1 to 4 |
| RAID 50 | 3 to 5 |

**Note:** Once you start expanding array capacity, you cannot stop it. The expand function may take an hour or more to complete, depending on the array type, array size, drive speed, and other processes running on the controller.

**To expand an array:**

1. From the System Menu, select **Array Menu** and press **Enter**.

   The Select Array screen displays with a list of existing arrays.

2. Select the array you want and press **Enter**.

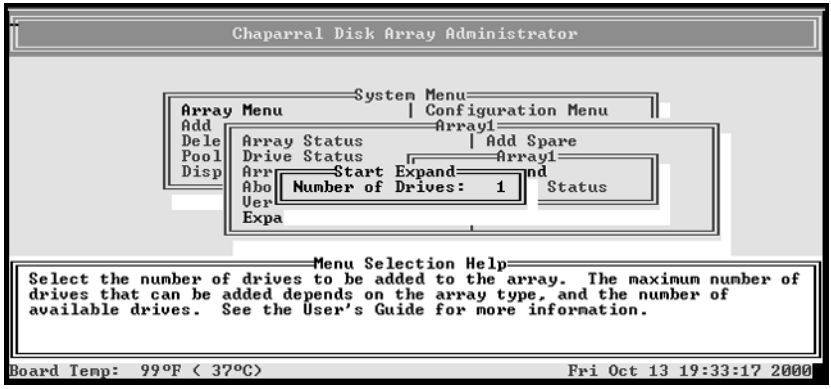
   The Array Menu screen displays.

3. Select **Expand Function** and press **Enter**.

   The expand menu displays.

4. Select **Start Expand** and press **Enter**.

   The Number of Drives screen displays.




5. Enter the number of drives you want to add and press **Enter**.

   The Select Drives screen displays.

**6** Press **Enter**.

The list of available drives screen displays.


**7** Select the drives you want to add from the list of available drives and press **Enter**.

Only available drives, that is, drives that are not members of an array and are not assigned as a dedicated or pool spares, display.

You select a drive by highlighting it and pressing **Enter**. Each selected drive turns gray in the drive list. After you press **Enter** for the number of drives you entered previously, the system automatically begins the expansion. To skip a drive, use the ↑ or ↓ keys.

Expansion begins and the percentage completed displays. To return to the Array Menu, press **Esc**. To check the progress of the expansion, you can use the expand status described below or select **Array Menu** from the System Menu. The status of the expansion displays in the list of arrays.

## Viewing Expand Status

You can view the status of the expansion process while it is running.

**To view expand status:**

**1** From the System Menu, select **Array Menu** and press **Enter**.

The Select Array screen displays with a list of existing arrays.

**2** Select the array you want and press **Enter**.

The Array Menu screen displays.

3 Select **Expand Function** and press **Enter**.

The expand menu displays.

4 Select **View Expand Status** and press **Enter**.

The Expand Status screen displays.

5 Press **Esc** to return to the expand menu.

## Changing the Array LUN

You can change the LUN assigned to an array, as it appears under the controller's target ID from the host system's point of view. The change takes place immediately, however, you may need to reboot the host system to see the array at the new LUN.

**Note:** You cannot change the array's LUN to one that is already in use. If you want to use a LUN that is already in use, you must first reassign the LUN in use.

For more information about LUNs and your controller, see *Understanding LUNs* on page 7-4.

**To change the array LUN:**

1 From the System Menu, select **Array Menu** and press **Enter**.

The Select Array screen displays with a list of existing arrays.

2 Select the array you want and press **Enter**.

The Array Menu screen displays.

3 Select **Change LUN** and press **Enter**.

The New LUN screen displays.

4 Enter the LUN you want to use and press **Enter**.

The system confirms that you want to make the change.

5 Select **Yes** and press **Enter**.

## Changing the Array Name

You can change the name of the array. This does not affect the target ID or LUN values of the array. The controller does not allow you to change an array name when a utility is running.

**To change the array name:**

1. From the System Menu, select **Array Menu** and press **Enter**.

   The Select Array screen displays with a list of existing arrays.

2. Select the array you want and press **Enter**.

   The Array Menu screen displays.

3. Select **Change Array Name** and press **Enter**.

   The Enter New Name screen displays.

4. Enter the name you want to use and press **Enter**.

   You can use up to 35 characters. You can include any characters in the name, including spaces.

   The system confirms that you want to make the change.

5. Select **Yes** and press **Enter**.

## Trusting an Array

You can use the Trust Array function to bring an array back online by resynchronizing the time and date stamp and any other metadata on a bad disk. This makes the disk an active member of the array again. You might need to do this when:

- One or more disks of an array start up more slowly or were powered on after the rest of the disks in the array. This causes the date and time stamps to differ, which the controller interprets as a problem with the "late" disks. In this case, the array will function normally after using Trust Array.
- An array is offline because a drive is failing, you have no data backup, and you want to try to recover the data from the array. In this case, the Trust Array function may work, but only as long as the failing drive continues to operate.

Before you can use this function, you must enable it in the Option Configuration menu.

**Caution:** The trust array feature can cause unstable operation and data loss if used improperly. This feature is intended for disaster recovery.

**To trust an array:**

1. From the System Menu, select **Configuration Menu** and press **Enter**.

   The Configuration Menu displays.

2. Selection **Option Configuration** and press **Enter**.

   The Option Configuration Menu displays.

3. Select **Enable Trust Array** and press **Enter**.

   The Enable Trust Array screen displays.

4. Select **Enable** and press **Enter**.

   The option is only enabled until you use it. After you trust an array, the option reverts back to being disabled.

5. Press **Esc** twice to return to the System Menu.

6. Select **Array Menu** and press **Enter**.

   The Select Array screen displays with a list of existing arrays.

7. Select the array you want and press **Enter**.

   The Array Menu screen displays.

8. Select **Trust Array** and press **Enter**.

   The system confirms that you want to trust the array.

9. Select **Yes** and press **Enter**.

   The array will be back online.

**Note:** If the array does not come back online, it may be that too many members are offline or the array may have additional failures on the bus or enclosure that Trust Array cannot fix.

## Deleting an Array

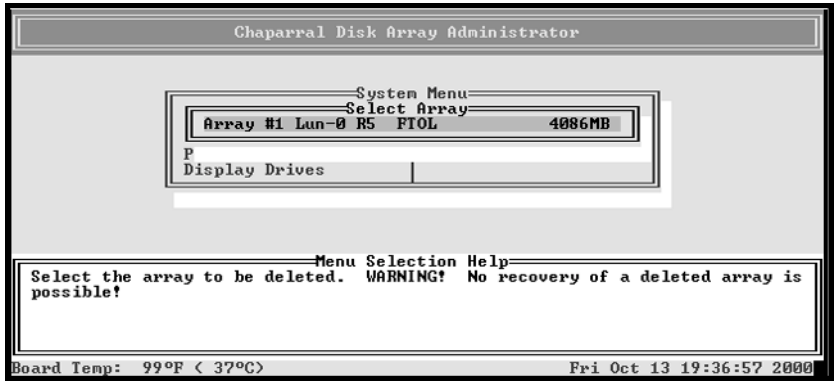
You can delete an array when you no longer need the array or you need the drives for another use.

**Caution:** Deleting an array deletes the data contained in the array; however, before reusing the drives, you should do a low-level format on each drive.

**Note:** You cannot delete an array while any utility (Initialize, Verify, Expand, or Reconstruct) is running on the array. You must stop the utility, if allowed, or let it finish before you can delete the array.

**To delete an array:**

1 From the System Menu, select **Delete an Array** and press **Enter**.




A list of arrays appears in the menu, if more than one array is exists.

2 Select the array you want to delete and press **Enter**.

The system asks you to confirm the deletion.

3 Select **Yes** and press **Enter**.

❒

# 5

# Monitoring System Status

You should monitor your system regularly to ensure that the controller, disks, and arrays are working properly. The Disk Array Administrator software lets you monitor the status several ways:

- Event log (see below)
- Hardware information (see *Displaying Hardware and Configuration Information* on page 5-5)
- Array status screen (see *Viewing Array Status* on page 4-8)
- Disk status screen (see *Viewing Drive Status* on page 4-13)
- Power On Self-Test (POST) (see *Problems During Bootup* on page 9-4)
- Overall Statistics screen (see *Displaying Overall Statistics* on page 5-11)

## Displaying the Event Log

The controller's event log contains important information about the status of the controller, disks, and arrays. You should check it regularly to monitor the status of your system. For more information about specific SCSI disk and channel errors, see *Understanding SCSI Errors* on page 9-9.

Below is a list of some of the key warning and failure events included in the log during operation:

- Disk detected error
- Disk channel error
- Battery failure
- Drive down
- Power up

- Array critical
- Array offline
- Temperature warning
- Temperature failure (this leads to a shutdown which is also logged)
- Voltage warning
- Voltage failure (this leads to a shutdown which is also logged)

The event log stores the most recent 400 events. Events are numbered sequentially from 001 to 999. The numbering wraps back to 001 after reaching 999.

**Note:** If you are having a problem with the controller or an array, check the event log before calling technical support. Event messages may let you resolve the problem without calling. You should also check Chapter 9, *Troubleshooting*.

You can view the event information three ways:

- Most recent event
- One event at a time, most recent event first
- Full page of events at a time

You can also capture the event log to a file. See *Capturing the Event Log File* on page 5-4.

## Viewing the Most Recent Event

The most recent voltage or temperature event displays in rotation with the date and time whenever the Disk Array Administrator times out and returns to its initial screen.

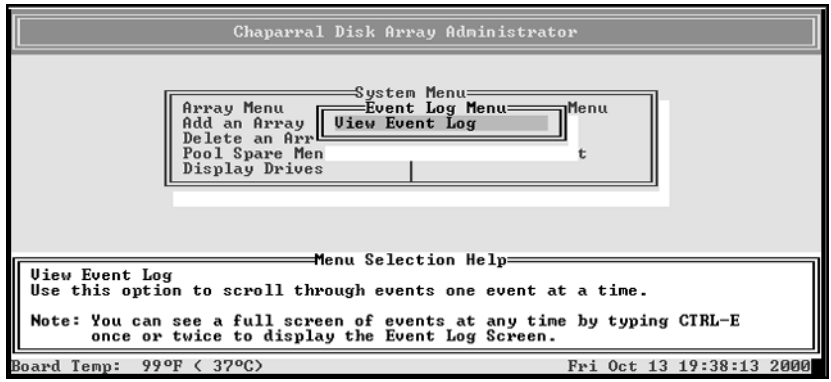
## Viewing One Event at a Time

You can view controller-related events one at a time. The events display in reverse chronological order, that is, the most recent event is first.

**To display one event at a time:**

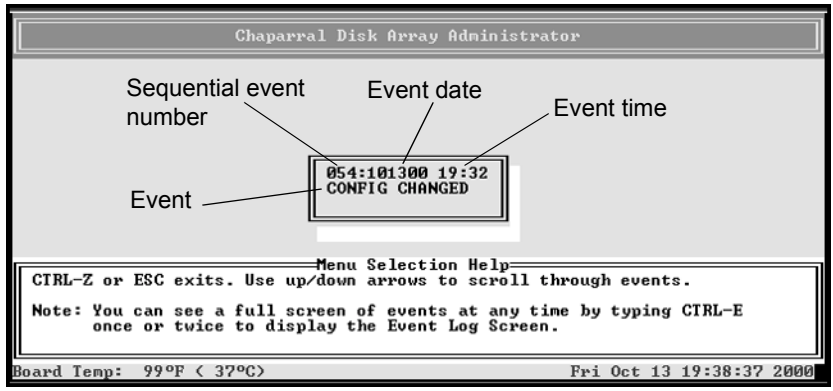
**1** From the System Menu, select **Event Log Menu** and press **Enter**.

The Event Log Menu screen displays.




**2** Select **View Event Log** and press **Enter**.

The Event Log screen displays the last event that occurred.




**3** Press ↑ to see the previous event.

You can continue to view earlier events by pressing ↑.

**4** Press **Esc** to return to the Event Log Menu.

## Viewing a Whole Screen of Events

You can also view events from the log file a whole screen at time. This lets you quickly review all recent events. The events display in chronological order, that is, the most recent event is last.

**To display a whole screen of events:**

1. From anywhere in the Disk Array Administrator software, press **CTRL-E**.

   The first screen of events from the event log displays.


2. Press **u** to page up or **d** to page down in the log.
3. Keep pressing **CTRL-E** to page through the other information screens and return to the menu.

## Capturing the Event Log File

You can also capture the entire event log, which saves it to a file on your hard drive. This is useful if you want to print the log or attach it to an e-mail message.

The steps below use HyperTerminal as the terminal emulator software. If you use a different terminal emulator, your procedure may be different.

**To capture the event log file:**

1. With HyperTerminal up and running as your RS-232 interface terminal, press **CTRL-E** until the event log displays.

2. From the Transfer menu in HyperTerminal, select Capture Text.

   The Capture Text window displays.

3. Enter the path and file name you want to use to store the log file contents.
4. Click **Start**.
5. Press **P** on the keyboard to begin the transfer.
6. From the Transfer menu in HyperTerminal, select Capture Text.

   The Capture Text window displays.

7. Click **Stop**.

# Displaying Hardware and Configuration Information

You can display the controller's hardware and configuration information. This is where you can see what version of the firmware you have. Chaparral technical support personnel may request this information.

You can display the hardware and configuration information two ways:

- Hardware information only
- Hardware and configuration information

Table 5-1 lists the configuration information that is available.

Table 5-1. Configuration information

| Group | Field | What displays | Field | What displays |
|---|---|---|---|---|
| HOST | Enabled | Field is just a placeholder. | SE/LVD (K5312 and G5312 only) | Negotiation rate. |
| | Target ID | SCSI ID of controller as set in the Disk Array Administrator software. | | |

Table 5-1. Configuration information (Continued)

| Group | Field | What displays | Field | What displays |
|---|---|---|---|---|
| | Controller LUN | SOFT, NONE, or specific number as set in the Disk Array Administrator software. | | |
| | Topology (G7313 and K7313 only) | Always Loop.* | | |
| | Node WWN (G7313 and K7313 only) | FC World Wide Name for node. | | |
| | Port WWN (G7313 and K7313 only) | FC World Wide Name for port. | | |
| | FC Addr (G7313 and K7313 only) | 24-bit FC address or None if the FC link is not active. | AL_PA (G7313 and K7313 only) | Currently assigned value or None if the FC link is not active. |
| | Loop ID (G7313 and K7313 only) | SOFT or a specific number as set in the Disk Array Administrator software. | Current | Currently assigned value or Inactive if the FC link is not active. |
| CHAN 0 | Initiator ID | SCSI ID of controller on Channel 0 as set in the Disk Array Administrator software. | Ultra/U2 | Hardware runs as Ultra2. |

Table 5-1. Configuration information (Continued)

| Group | Field | What displays | Field | What displays |
|---|---|---|---|---|
| CHAN 1 | Initiator ID | SCSI ID of controller on Channel 1 as set in the Disk Array Administrator software. | Ultra/U2 | Hardware runs as Ultra2. |
| CHAN 2 | Initiator ID | SCSI ID of controller on Channel 2 as set in the Disk Array Administrator software. | Ultra/U2 | Hardware runs as Ultra2. |
| CONTROLLER | Backoff | Percentage set in Disk Array Administrator software. 1% is default and recommended value. | Utility Pri | HIGH, MED, or LOW utility priority as set in Disk Array Administrator software. |
| | Alarm Mute | ON or OFF as set in Disk Array Administrator software. | Battery | ENABLED or DISABLED as set in Disk Array Administrator software. |
| | Cache Lock | ON or OFF as set in Disk Array Administrator software. | Dyn. Spare | ON or OFF as set in Disk Array Administrator software. |
| CAPI | Version | Version of the Configuration Application Programming Interface. | | |

Table 5-1. Configuration information (Continued)

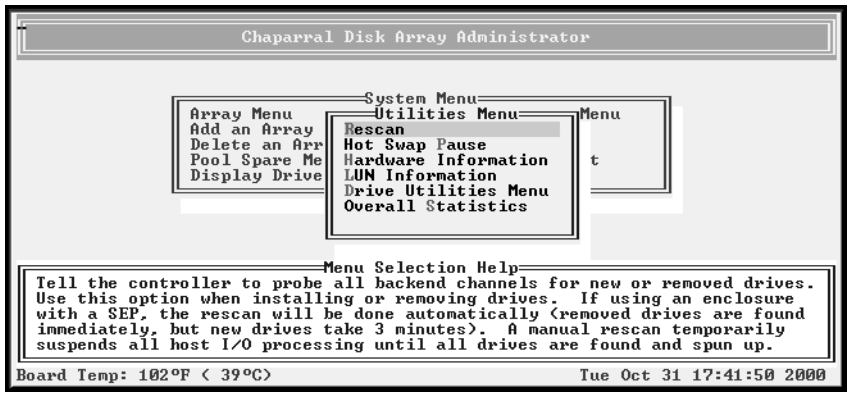
| Group | Field | What displays | Field | What displays |
|---|---|---|---|---|
| SEP | Poll Rate | Number of seconds as set in the Disk Array Administrator software. | Temperature | ON or OFF as set in Disk Array Administrator software. |
| | Slot flags | ON or OFF as set in Disk Array Administrator software. | Global Flags | ON or OFF as set in Disk Array Administrator software. |

* If you have installed the new optional Fibre Channel interface upgrade, you can also use the Point-to-Point topology.

**To display hardware information only:**

**1** From the System Menu, select **Utilities Menu** and press **Enter**.

The Utilities Menu screen displays.



**2** Select **Hardware Information** and press **Enter**.

The Hardware Information screen displays.


**3** Press **Esc** to return to the Utilities Menu.

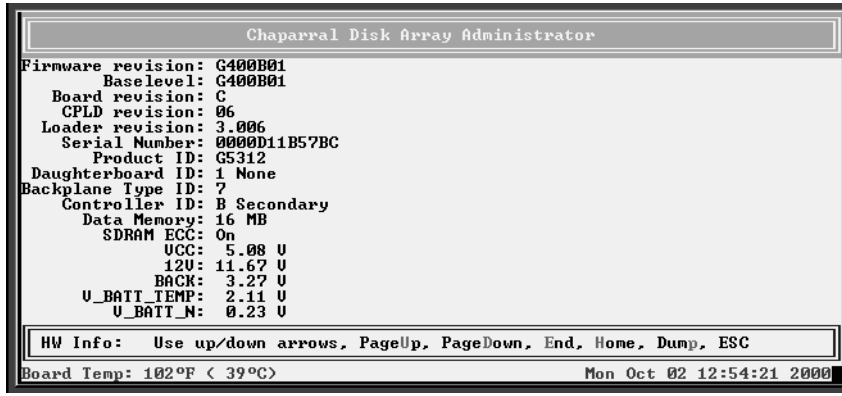
**To display hardware and configuration information:**

1. From anywhere in the Disk Array Administrator software, press **CTRL-E**.

   The first screen of events from the event log displays.

2. Press **CTRL-E** again.

   The Hardware Information screen displays.




3. Press **CTRL-E** again.

   You can press **Esc** to return to the previous screen.

   The Configuration Information screen displays.


4. Press **CTRL-E** or **Esc** to return to where you started from.

# Displaying Overall Statistics

You can display two types of aggregate statistics for all array LUNs:

- General statistics (Similar statistics are also available for individual array LUNs. For more information, see *Viewing Array Statistics* on page 4-10.)
  - I/O operations per second (IOPS)
  - Bandwidth (in millions of bytes per second)
  - Number of read operations
  - Number of write operations
  - Total sectors (512 byte) read
  - Total sectors written
  - Total current command queue depth across all LUNs
- Host read/write histogram that shows how many host reads and writes fell into a particular size range. The I/O ranges are based on powers of two:
  - 1 Sector
  - 2-3 Sectors
  - 4-7 Sectors
  - 8-15 Sectors
  - 16-31 Sectors
  - 32-63 Sectors
  - 64-127 Sectors
  - 128-255 Sectors
  - 256-511 Sectors
  - 512-1023 Sectors
  - 1024-2047 Sectors
  - 2048 (and larger) Sectors

This information may be helpful in interpreting performance based on individual system configurations and operating systems. The information displayed here can be useful to profile applications and their usage of the array and what type of RAID level is applicable to your needs.

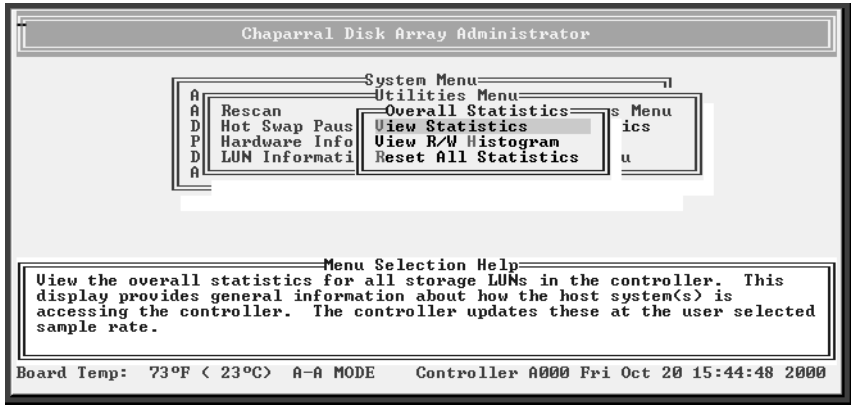
**To access the general array statistics:**

1. From the System Menu, select **Utilities Menu** and press **Enter**.

   The Utilities Menu screen displays.

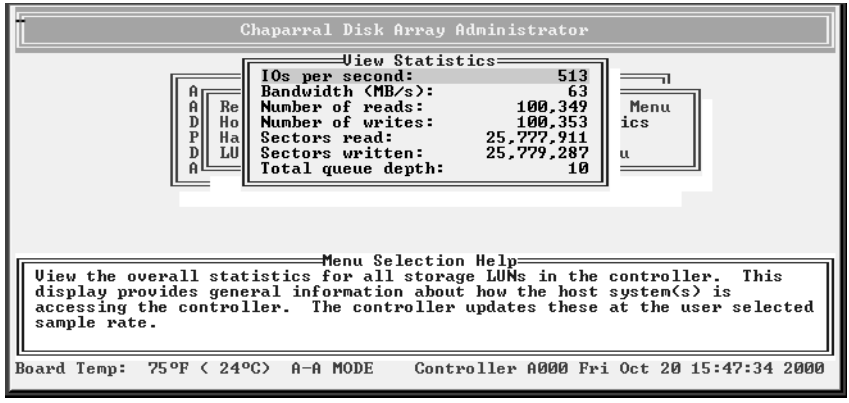
2. Select **Overall Statistics** and press **Enter**.

   The Overall Statistics screen displays.




3. Select **View Statistics** and press **Enter**.

   The View Statistics screen displays.




4. Press **Esc** to return to the Overall Statistics screen.

**To access the read/write histogram:**

1. From the System Menu, select **Utilities Menu** and press **Enter**.

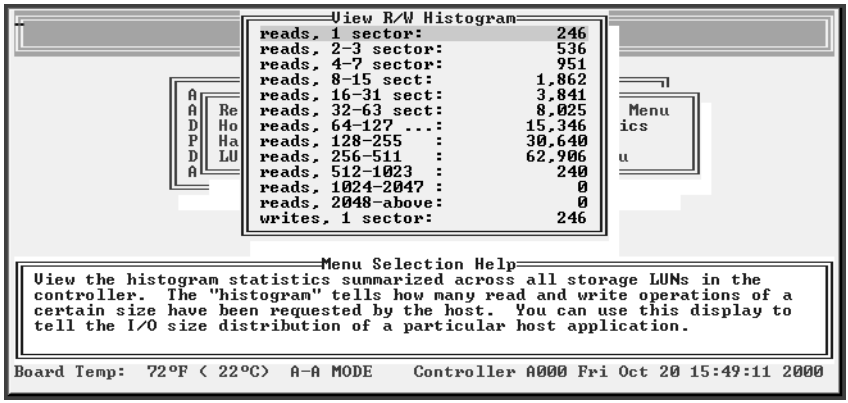
   The Utilities Menu screen displays.

2. Select **Overall Statistics** and press **Enter**.

   The Overall Statistics screen displays.

3. Select **View R/W Histogram** and press **Enter**.

   The View R/W Histogram screen displays.




4. Press **Esc** to return to the Overall Statistics screen.

## Resetting Overall Statistics

You can also reset all of the overall statistics back to zero. You may want to reset the statistics if you are monitoring performance or doing benchmark testing.

**Note:** Resetting statistics here also resets the statistics for each individual array. See *Viewing Array Statistics* on page 4-10.

**To reset overall statistics:**

1. From the System Menu, select **Utilities Menu** and press **Enter**.

   The Utilities Menu screen displays.

2. Select **Overall Statistics** and press **Enter**.

   The Overall Statistics screen displays.

3. Select **Reset All Statistics** and press **Enter**.

   The system confirms that you want to make the change.

4. Select **Yes** and press **Enter**.

   The system confirms that the statistics have been cleared and returns to the Overall Statistics screen.

# 6

# Managing Spares

Chaparral RAID controllers automatically reconstruct redundant (fault-tolerant) arrays (RAID 3, RAID 4, RAID 5, RAID 50, and mirrored) if an array becomes critical and a properly sized spare drive is available. An array becomes critical when one or more member drives fails.

You can set up two types of spare drives:

- Dedicated—available drive that is assigned to a specific array. See page 6-1.
- Pool—available drive that is assigned to the pool, which can provide a spare for any failed drive in any redundant array. See page 6-5.

In addition, if you enable the Dynamic Spares option and a drive fails, you can replace the drive and the controller will rescan the bus, find the new disk drive, and automatically start reconstruction of the array. See page 6-3.

The controller looks for a dedicated spare first. If it does not find a properly sized dedicated spare, it looks for a pool spare.

If a reconstruct does not start automatically, it means that no valid spares are available. To start a reconstruct, you must:

1. Replace the failed drive, if no other drive is available.
2. Add the new drive or another available drive as a dedicated spare to the array or as a pool spare.

   Remember that any pool spares added might be used by any critical array, not necessarily the array you want

## Managing Dedicated Spares

Dedicated spares are unused disk drives that you assign as a spare to a specific array. The disk must be as large as the smallest member of the array. You cannot use a dedicated spare drive in an array or as a pool spare.

While using a dedicated spare is the most secure way to provide spares for your arrays, it is also expensive to keep an idle drive assigned to each array. An alternative method is to assign one or more idle drives to the spare pool. See *Managing the Spare Pool* on page 6-5.

## Adding a Dedicated Spare

You assign dedicated spare drives to a specific array. If a member drive in the array fails, the controller uses a dedicated spare drive to automatically reconstruct the array. You can add dedicated spare drives to Mirrored (RAID 1 and RAID 10) and Parity (RAID 3, RAID 4, RAID 5, and RAID 50) arrays when you create the array or afterward. You can assign up to four dedicated spare drives to an array. For more information about assigning spares when you create an array, see *Creating Arrays* on page 4-1.

**Note:** A spare cannot be added that does not have enough capacity to replace the smallest member in the array.

**To add a dedicated spare:**

1. From the System Menu, select **Array Menu** and press **Enter**.

   The Select Array screen displays with a list of existing arrays.

2. Select the array you want and press **Enter**.

   The Array Menu screen displays.

3. Select **Add Spare** and press **Enter**.

   The list of drives screen displays listing the available drives.

**Note:** If a drive was a member of an array and was removed from the array, you cannot use it as a spare until you clear the drive's metadata. For more information, see *Clearing Metadata from a Drive* on page 8-4.

4. Select the drive you want to add as a spare and press **Enter**.

   The system confirms the change.

5. Select **Yes** and press **Enter**.

## Deleting a Dedicated Spare

You can delete a dedicated spare drive from an array at any time.

**To delete a dedicated spare drive:**

1. From the System Menu, select **Array Menu** and press **Enter**.

   The Select Array screen displays with a list of existing arrays.

2. Select the array you want and press **Enter**.

   The Array Menu screen displays.

3. Select **Delete Spare** and press **Enter**.

4. Select the spare drive you want to delete and press **Enter**.

   The system confirms the deletion.

5. Select **Yes** and press **Enter** to delete the spare.

   The drive is now available for use in an array or as a spare.

# Enabling Dynamic Spares

The Dynamic Spares option lets you use all of your disk drives in redundant arrays, without assigning one as a spare. For example, if you enable Dynamic Spares and a drive fails, you can replace the drive and the controller will rescan the bus, find the new disk drive, and automatically start reconstruction of the array. The controller automatically finds the new drive and reconstructs the array.

With Dynamic Spares enabled, if you have spares or available drives, the controller first looks for a dedicated or spare pool drive for the reconstruction. If none is found, it uses an available drive, which the controller automatically assigns as a spare and starts reconstruction.

You must make sure that the new or available drive has enough capacity to replace the smallest member in the array and does not contain metadata (see *Clearing Metadata from a Drive* on page 8-4).

**Note:** Performance in systems without a SAF-TE Enclosure Processor (SEP) will decrease if an array becomes critical with this option enabled and there are no available drives to start a reconstruct. To minimize the performance impact, increase the rescan rate as described in the steps below.

**To enable dynamic spares:**

1. From the System Menu, select **Configuration Menu** and press **Enter**.

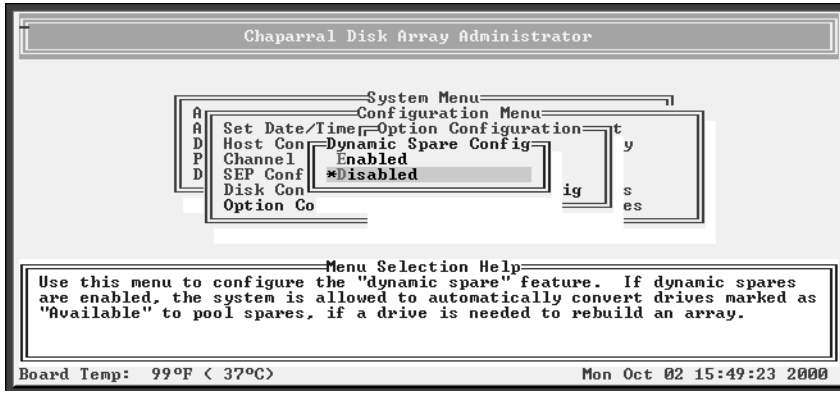
   The Configuration Menu screen displays.

2. Select **Option Configuration** and press **Enter**.

   The Option Configuration screen displays.

3. Select **Dynamic Spare Configuration** and press **Enter**.

   The Dynamic Spare Config screen displays. The current setting is marked with an * next to it.




4. Select **Enabled** and press **Enter**.

   The Rescan Rate screen displays.

5. Enter the rescan rate in minutes.

   This tells the controller how often it should look for an available drive by rescanning the bus. Remember that rescanning the bus frequently can affect performance. If you have a SEP, the dynamic spare configuration will not rescan the bus. The SEP will detect the new drive and tell the controller to rescan and the rescan rate you set here will not affect the system.

   The system confirms the change.

6. Select **Yes** and press **Enter**.

# Managing the Spare Pool

The spare pool lets you have one or more disk drives available for the reconstruction of redundant arrays (Mirrored [RAID 1 and RAID 10] and Parity [RAID 3, RAID 4, RAID 5, and RAID 50]) arrays. Once you assign a drive to the spare pool, it is not available for use as an array member or as a dedicated spare.

If a pool spare is too small (smaller than an individual member in an array), the controller cannot use it.

## Adding a Spare to the Spare Pool

You can add up to eight drives to the spare pool to reconstruct any critical array on the controller. After an array has started using a pool spare, other critical arrays are prevented from using it. For a pool spare to be used, it must be at least as large as the minimum drive size in the array.

**To add a pool spare:**

1 From the System Menu, select **Pool Spare Menu** and press **Enter**.

The Pool Spare Menu screen displays.

2 Select **Add Pool Spare** and press **Enter**.

The Select Drives screen displays.


3 Select each spare drive you want to add and press **Enter.**

## Deleting a Spare from the Spare Pool

You can delete a spare from the spare pool at any time.

**To delete a spare from the spare pool:**

1 From the System Menu, select **Pool Spare Menu** and press **Enter**.

The Pool Spare Menu screen displays.

2 Select **Delete Pool Spare** and press **Enter**.

The Delete Pool Spare screen displays listing the drives assigned to spare pool.

3 Select the pool spare you want to delete and press **Enter.**

## Displaying the Spare Pool

You can display a list of the all of the pool spares.

**To display the spare pool:**

1. From the System Menu, select **Pool Spare Menu** and press **Enter**.

   The Pool Spare Menu screen displays.

2. Select **Display Pool Spares** and press **Enter**.

   The Display Pool Spare screen displays listing all disk drives assigned to the spare pool.

3. Press **Esc** to return to the Spare Pool Menu.

# 7

# Configuring the Controller

The Disk Array Administrator lets you configure settings and perform a variety of functions on the controller. You can:

- Reboot the controller (see page 7-1)
- Change the date and time (see page 7-2)
- Change the LUN and target ID or FC Loop ID (see page 7-4)
- Configure the SCSI channels (see page 7-9)
- Set up LUN zoning (see page 7-11)
- Change the sample rate (see page 7-17)
- Change the alarm mute setting (see page 7-18)
- Lock the cache setting (see page 7-20)
- Enable or disable the battery (see page 7-21)
- Change the I/O priority (see page 7-22)
- Rescan all channels (see page 7-23)
- Pause I/O (see page 7-24)
- Restore the default settings (see page 7-25)
- Upgrade the firmware (see page 7-26)

## Rebooting the Controller

You may need to shut down and restart the controller after making certain configuration changes and when you move it or make hardware changes. We strongly recommend that you shut down the controller gracefully and do not just turn off the power. A normal shut down ensures that the write-back cache has been flushed to the disk.

**Caution:** Anyone accessing an array when you shut down the controller will lose access and may lose data.

**To shut down and restart the controller:**

1. From the System Menu, select **Shutdown/Restart** and press **Enter**.

   The system confirms that you want to shut down.

2. Select **Yes** and press **Enter**.

   The system confirms that it has shut down.

3. Press **Enter** to reboot.

   The system performs its self-test. When you see the Disk Array Administrator initial screen, the controller is ready. See Chapter 3, *Accessing the Disk Array Administrator Software*.

# Changing the Date and Time

You can change the controller's date and time.

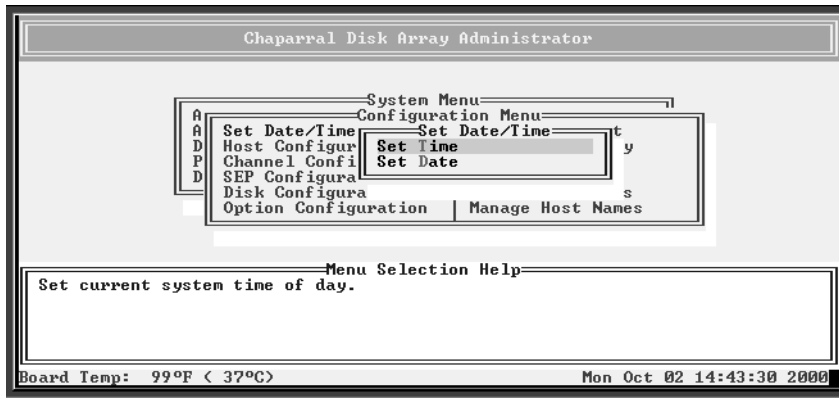
**To set the controller's date:**

1. From the System Menu, select **Configuration Menu** and press **Enter**.

   The Configuration Menu screen displays.

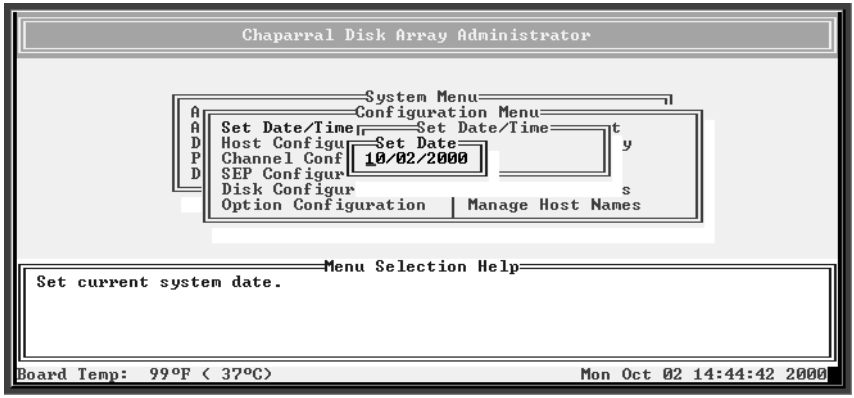
2. Select **Set Date/Time** and press **Enter**.

   The Set Date/Time screen displays.



**3** Select **Set Date** and press **Enter**.

The Set Date screen displays.




**4** Enter the date you want and press **Enter**.

Enter the date in the following format: MM/DD/YYYY.

The system confirms that you want to make the change.

**5** Select **Yes** and press **Enter** to make the changes.

The system confirms that the changes are made.

**6** Press **Esc** to return to the Configuration Menu.

**To set the controller's time**:

**1** From the System Menu, select **Configuration Menu** and press **Enter**.

The Configuration Menu screen displays.

**2** Select **Set Date/Time** and press **Enter**.

The Set Date/Time screen displays.

3 Select **Set Time** and press **Enter**.

The Set Time screen displays.


4 Enter the time you want and press **Enter**.

Enter the time in the following format: hh:mm:ss.

The system confirms that you want to make the change.

5 Select **Yes** and press **Enter** to make the changes.

The system confirms that the changes are made.

6 Press **Esc** to return to the Configuration Menu.

# Changing the Controller's LUN and SCSI Target ID or Fibre Channel Loop ID

You can change the SCSI target ID or the Fibre Channel Loop ID and the LUN that the controller uses on the host bus.

## Understanding LUNs

The RAID controller supports up to eight SCSI Logical Unit Numbers (LUNs) that are numbered zero through seven. There are three different types of LUNs: controller, SEP, and Array. These LUNs have the following characteristics:

- Controller LUN—You only need to assign a controller LUN if you are using the Configuration Application Program Interface (CAPI) to configure the controller over a host channel via SCSI protocol extensions. If you are not using CAPI, you can set the controller LUN to NONE. If you are using CAPI, you can set it to a value of 0-7 or SOFT. If set to SOFT, the controller LUN is automatically assigned a LUN value when the controller boots. The soft LUN value will be assigned to the first available LUN (starting from zero) that does not already have a hard (that is, a numeric) LUN assignment.

**Note:** Most Unix, Linux, and Macintosh operating systems require the controller LUN to be a higher value than all array LUNs. Before creating your first array, change the controller LUN to a higher value or choose NONE (best choice) if you are not using CAPI to manage the arrays. This allows your first array to be seen at LUN 0.

- SEP LUNs—Allow access to SEPs. A SEP LUN may be set to a value of 0-7, SOFT (see the controller LUN description for the meaning of SOFT), or NONE. NONE means that the SEP cannot be accessed via a LUN. Note that if both a controller LUN and a SEP LUN are set to SOFT, the controller LUN will be assigned a value first. For information about changing the SEP LUN, see *Changing the SEP LUN* on page 8-12.
- Array LUNs—Allow access to arrays on the controller. Array LUNs may be set any numeric value from 0-7. They may not be set to a SOFT value. Note that an array LUN value may be set to overlap a SOFT controller LUN value. In this case, the controller will keep the numeric value of the overlapped LUN (and the array will not be visible) until you reboot, after which the array will take the LUN, and the controller LUN will change to first available SOFT LUN value. For information about changing the array LUN, see *Changing the Array LUN* on page 4-21.

**Note:** Because a maximum of eight LUNs are supported, if eight arrays are required, the controller and SEP LUNs will not be accessible, and must be set to SOFT or NONE.

## Changing the Controller's Target ID and LUN

You can change the controller's target ID or LUN, if necessary:

- Target ID—This is either the SCSI target ID for the G5312 or K5312 or the controller's FC Loop ID for the G7313 or K7313.
  - SCSI target ID—You may need to change controller's SCSI target ID when you have existing devices at ID 1, the controller's default, or when you are adding more than one controller to a system.You can set the target ID to any number between 0 and 15.
  - FC Loop ID—You may need to change this if you want the controller to be at a specific address or if your system checks addresses in reverse order (lowest address first). You have two options:

    SOFT—Use this setting if you do not care if the controller's Loop ID changes when you power down and power up. This setting lets the FC loop initialization process determine the Loop ID.

    Any number between 0 and 125—Select a specific number if you want the Loop ID to stay the same after you power down and power up. The Disk Array Administrator software cannot tell you which Loop IDs are available. To be sure that you have successfully assigned the Loop ID you want, check the Loop ID after you reboot the controller. If the controller cannot get the specified Loop ID during the loop initialization process, it will try to get a soft address.
- LUN—You only need to assign a controller LUN if you are using the Configuration Application Program Interface (CAPI) to configure the controller over a host channel via SCSI protocol extensions.

  If you are not using CAPI, you can set the controller LUN to NONE. If you are using CAPI, you can set it to a value of 0-7 or SOFT. If set to SOFT, the controller LUN is automatically assigned a LUN value when the controller boots. The soft LUN value will be assigned to the first available LUN (starting from zero) that does not already have a hard (that is, a numeric) LUN assignment.

  You can have three options for setting the LUN:
  - NONE—Use this setting if you are not using CAPI to configure the controller (this change takes effect immediately).
  - SOFT—Use this setting if you do not care if the controller's LUN changes when you reboot the controller.

– Any number between 0 and 7—Select a specific number if you want the controller's LUN to stay the same when you reboot.

**To change the controller's target ID and LUN:**

**1** From the System Menu, select **Configuration Menu** and press **Enter**.

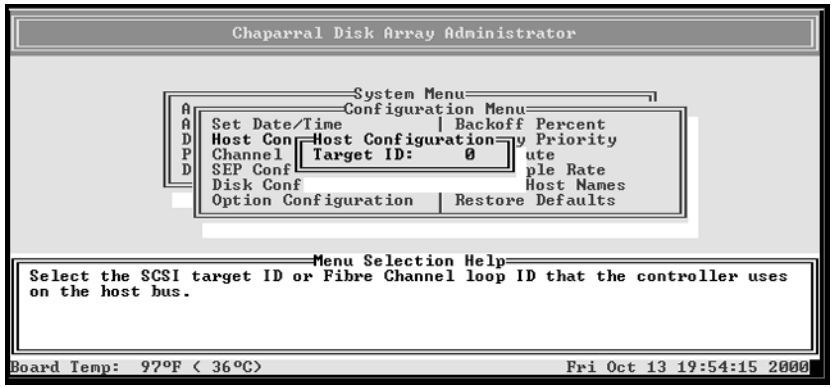
The Configuration Menu screen displays.

**2** Select **Host Configuration** and press **Enter**.

The Host Configuration screen displays.

**3** Select **Target ID** and press **Enter**.

The Target ID screen displays.

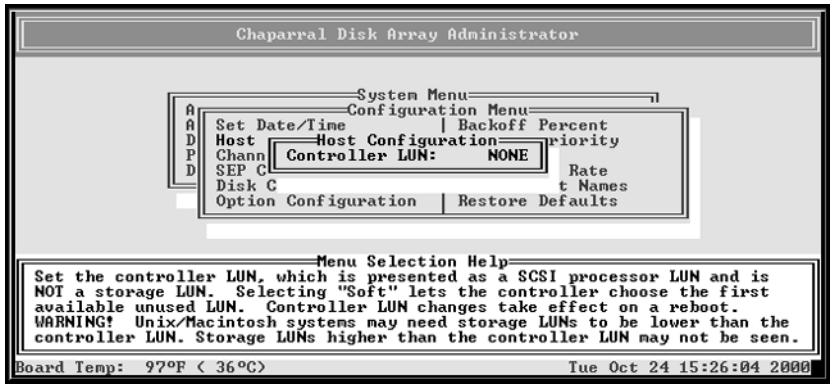



**4** Select the option or number you want to use and press **Enter**.

| To | Do this |
|---|---|
| Set a SCSI Target ID | ■ Select the [target ID] you want to use and press **Enter**.<br>This can be any number from 0 to 15. |
| FC Loop ID<br>Let the FC loop initialization process determine the Loop ID for the channel each time the controller powers up | ■ Select **SOFT** and press **Enter**.<br>This is the default setting. |

| To | Do this |
|---|---|
| Keep the same Loop ID for the channel at all times | ■ Select the [Loop ID] you want to use and press **Enter**.<br>This can be any number from 0 to 125. |

The Controller LUN screen displays.




**5** Select the option or number you want to use.

| To | Do this |
|---|---|
| Not assign the controller a LUN | ■ Select **NONE** and press **Enter**. |
| Let the controller determine the channel LUN each time it powers up | ■ Select **SOFT** and press **Enter**.<br>This is the default setting. |
| Keep the same LUN for the controller at all times | ■ Select the [LUN] you want to use and press **Enter**.<br>This can be any number from 0 to 7. |

The system confirms that you want to make the change.

**6** Select **Yes** and press **Enter** to make the changes.

# Configuring the SCSI Channels

You can change two channel configuration options for each channel:

- Channel speed—You can change the channel speed for each SCSI channel on the controller. You can select Ultra or Ultra2. This is helpful if you are troubleshooting a problem on the channel or if you have legacy ultrawide disk drives.

**Note:** Ultra/Ultra2 SCSI is enabled by default. This means that for a single-ended bus, transfer rates are 40 MB/sec maximum; for an LVD bus, 80 MB/sec maximum. This Ultra SCSI setting only affects the device channel. Host SCSI channel rates are controlled by setting the host adapter.

- SCSI ID assigned to each channel (initiator ID)—The controller assigns each of its SCSI channels one of the SCSI IDs (initiator IDs), leaving 15 SCSI IDs available for devices. You can change the SCSI ID assigned to each channel. You may need to do this if the default ID, 7, conflicts with a SEP ID. You can set the ID to any number between 0 and 15.

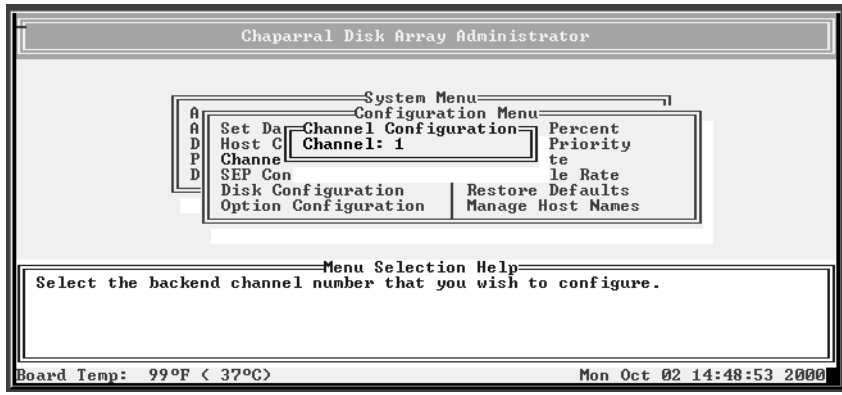
**To configure the channel:**

1. From the System Menu, select **Configuration Menu** and press **Enter**.

   The Configuration Menu screen displays.

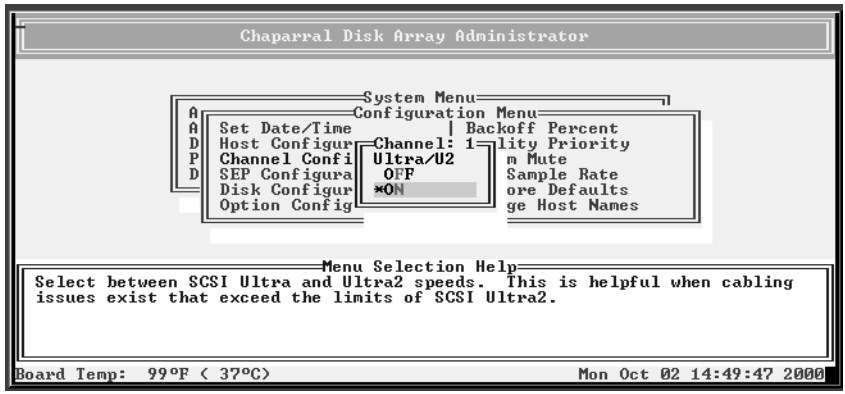
2. Select **Channel Configuration** and press **Enter**.

   The Channel Configuration screen displays.



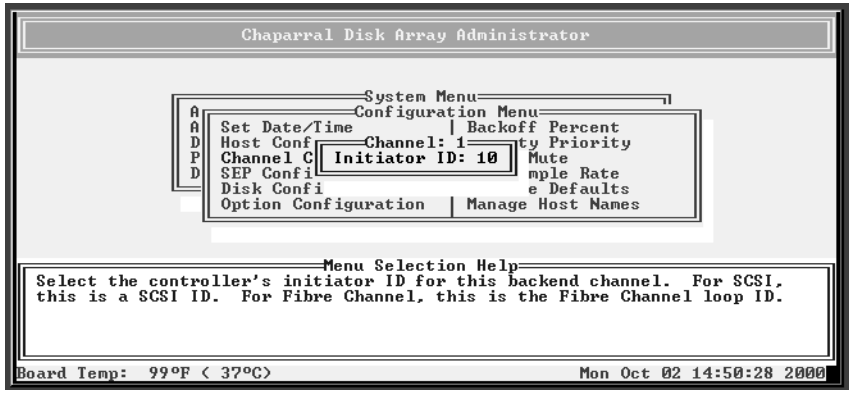
**3** Select the channel you want and press **Enter**.

The Ultra/U2 screen displays.The current setting is marked with an * next to it




**4** Select the setting you want and press **Enter**.

The initiator ID screen displays showing the current initiator ID.




**5** Select the initiator ID you want and press **Enter**.

The system confirms that you want to make the change.

**6** Select **Yes** and press **Enter** to make the changes.

**7** Press **Esc** to return to the Configuration Menu.

# Working with LUN Zoning

The controller's LUN zoning capability lets you specify which servers (hosts) can access each array. This gives you complete control of array access based on your specific needs. LUN zoning is only available on the G7313 and K7313 models.

Figure 7-1 shows an example of how you can use LUN zoning.

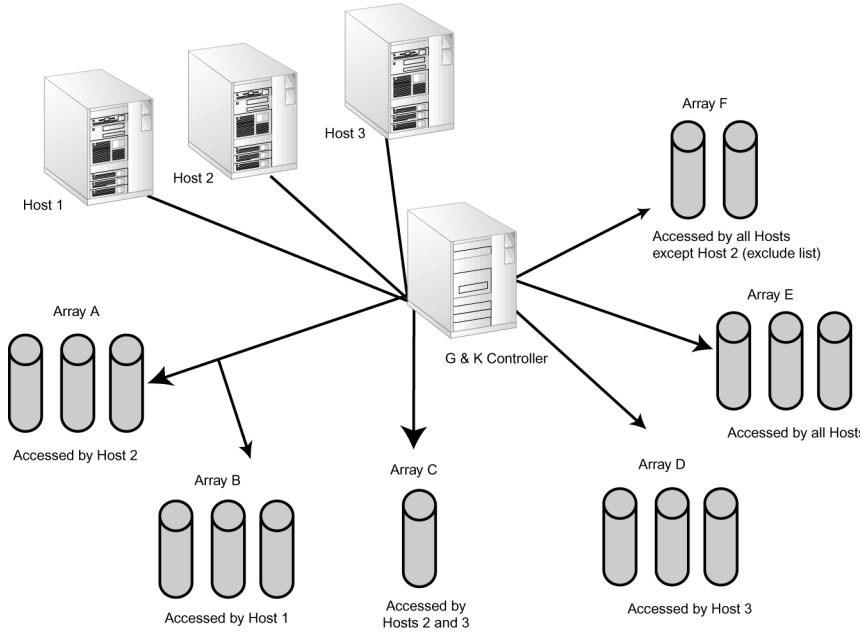



Figure 7-1. LUN zoning example

Before you set up LUN zoning, you should know the World Wide Name (WWN) for each server that you want to set up. Your SAN administrator should know the WWNs for your network. You can display a list of all WWNs that the controller is aware of on the SAN, and you can give each WWN a name (alias) of your own. This makes working with the LUN zoning feature faster and easier.

You set up LUN zoning by either excluding or including servers on a list for each array LUN. The list can include or exclude up to 16 specific servers or all servers for each array LUN.

For example, in Figure 7-1, Array A has an include list that only contains Host 2, so only Host 2 can access Array A. Array F has an exclude list that contains only Host 2, so all hosts *except* for Host 2 can access the array.

## Viewing Known WWNs

You can view a list of all server (host) WWNs that the controller is aware of on your SAN. The controller will be aware of any server that was booted since the controller was last restarted. Typically, servers scan for devices during their device discovery process. When this happens, the controller saves the WWN information for the server and retains the information even after you reboot the controller.

You can determine which WWN is for which server by booting one server at a time and then viewing the WWN list. The most recently booted server is first on the list. You can then give the servers names you recognize, for example you can use the computer name that has already been assigned to each server, to make LUN zoning easier to manage.

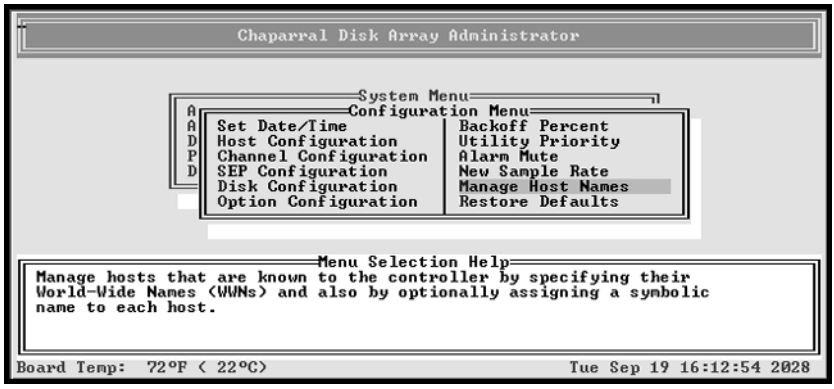
**To view known WWNs:**

1. From the System Menu, select **Configuration Menu** and press **Enter**.

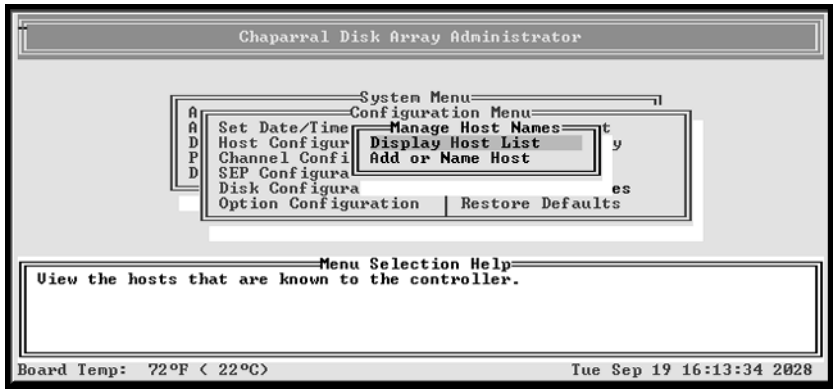
   The Configuration Menu screen displays.

2. Select **Manage Host Names** and press Enter.

   The Manage Host Names screen displays.



**3** Select **Display Host List** and press **Enter**.




The Display Host List screen displays showing all WWNs known to the controller. The WWNs are listed according the when they were booted. The most recently booted server (host) is listed first

**Note:** A hosts WWN can be placed at the top of the known hosts list whenever the host performs a device discovery or bus scanning type of operation.


**4** Press **Esc** to return to the Manage Host Names screen.

## Creating Names (Aliases) for Server WWNs

You can give the servers on your SAN names (aliases) that you can easily recognize to make LUN zoning easier to manage. For example, you can use the computer name that has already been assigned to each server.

You can determine which WWN is for which server by booting one server at a time and then viewing the WWN list. The most recently booted server is first on the list.

You can name up to 63 servers. The names are stored on the controller, so if you change controllers, you have to rename the servers.

**To create or change names for WWNs:**

1. From the System Menu, select **Configuration Menu** and press **Enter**.

   The Configuration Menu screen displays.

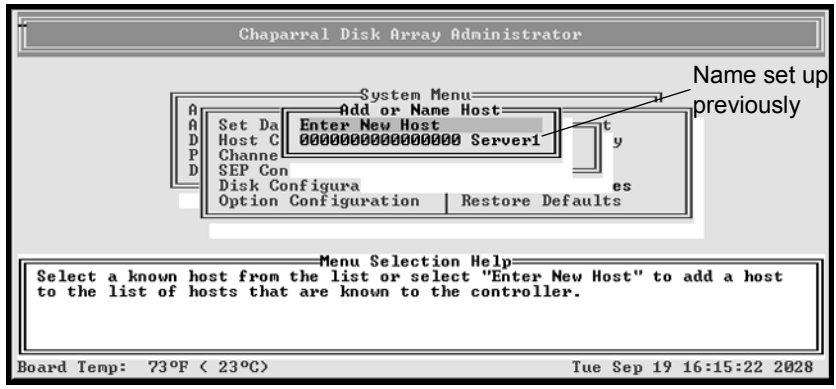
2. Select **Manage Host Names** and press Enter.

   The Manage Host Names screen displays.

3. Select **Add or Name Host** and press **Enter**.

   The Add or Name Host screen displays all known WWNs and host names that you have set up. If you want to change the name (alias), enter the new name in Step 5. For more information see *Viewing Known WWNs* on page 7-12.

   If the controller is not aware of any WWNs, the list is empty. Select **Enter New Host** to enter a WWN.



**Note:** If you have not manually assigned a WWN an alias, the controller will attempt to give the WWN a default name. The default name, if available, is the name of the manufacturer of the server's host bus adapter (HBA), enclosed in angle brackets. For example, a Qlogic HBA will have a default name of <Qlogic>.

4 Select the WWN you want to name and press **Enter**.

The Enter Host Name screen displays.

5 Enter the name (alias) you want and press **Enter**.

You can enter up to 16 characters. You can use any combination of characters and spaces.

## Configuring LUN Zoning

Once you set up server (host) names (aliases), you can easily set up your LUN zoning. This is where you determine which servers can access each array LUN.

You set up LUN zoning by either excluding or including servers on a list for each array LUN. The list can include or exclude up to 16 specific servers or all servers for each array LUN.

The zoning information is stored as part of the array's metadata using the WWN for each server. If you install a new controller, the array's LUN zoning will remain. The LUN zoning will also remain if you change the array's LUN.

**Note:** Changes to LUN zoning take effect immediately, therefore, you should make changes that limit access to arrays when the arrays are not in use.

**To set up LUN zoning:**

1 From the System Menu, select **Array Menu** and press **Enter**.

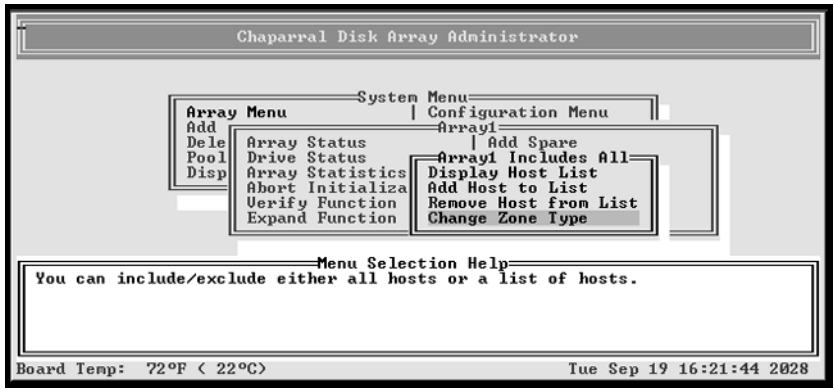
The Select Array screen displays with a list of existing arrays.

2 Select the array you want and press **Enter**.

The Array Menu screen displays.

**3** Select **LUN Zoning** and press **Enter**.

The LUN Exclude List or LUN Include List screen displays. The default setting for each array LUN is Include All Hosts. This results in all servers (hosts) being able to access all arrays. You can change the list type using the Change Zone Type option. See the next step.




**4** Select the option you want and press **Enter**.

- **Display Host List—**Displays a list of the servers (hosts) currently on the include or exclude list for the selected array. This option only displays servers if you have already used Add Host to List and added one or more WWNs to an include or exclude list.
- **Add Host to List**—Displays the Enter Host WWN screen where you enter the WWN or name (alias) or select the server you want to add to the current list for the selected array. Enter the WWN or name (alias) or select the server from the list and press **Enter**.
- **Remove Host from List**—Displays the Remove Host from List screen which contains a list of the servers (hosts) currently on the include or exclude list for the selected array. Select the WWN of the server you want to remove from the list and press **Enter**.
- **Change Zone Type**—Displays the Change Zone type screen where you can change the type of zoning to one of four options described below. Changing the zone type does not add or remove any hosts in previously created lists.

**Include All Hosts**—Permits all servers (hosts) on the network to access the selected array. This is the default zone type. This results in all servers (hosts) being able to access all arrays. If you have already created an include or exclude list, you can use this option to override the list. Your existing list is retained and you can display, add, or remove servers from the list.

**Include Listed Hosts**—Lets you enter or select the WWNs of the specific servers (hosts) you want to be able to access the selected array.

**Exclude All Hosts**—Permits *no* servers (hosts) on the network to access the selected array. If you have already created an include or exclude list, you can use this option to override the list. Your existing list is retained and you can display, add, or remove servers from the list.

**Exclude Listed Hosts**—Lets you enter or select the WWNs or names (aliases) of the specific servers (hosts) you do *not* want to be able to access the selected array.

Whether you use an include or exclude list depends on your needs. You may want to determine which list would be shorter and create the shorter list.

If you have changed the LUN zoning, the system confirms that you want to make the change.

5 Select **Yes** and press **Enter** to make the changes.

The system confirms that the changes are made.

6 Press **Esc** to return to the LUN Zoning screen.

# Changing the Sample Rate

You can set how often the controller samples data when updating status screens (disk and array). The default is one second.

**To change the sample rate:**

1 From the System Menu, select **Configuration Menu** and press **Enter**.

The Configuration Menu screen displays.

2 Select **New Sample Rate** and press **Enter**.

The New Sample Rate screen displays.

3 Enter the sample rate and press **Enter**.

# Changing the Alarm Mute Setting

You can enable or disable the audible alarm that sounds when the controller becomes too hot, detects low or high voltage, or an array becomes critical or offline. Changing the mute setting lets you turn off the alarm when it is sounding. You should turn it back on after resolving the problem.

The alarm sounds for temperature or voltage conditions (events). Warning events are generated when the temperature or voltage enters the warning range. Shutdown events are generated when the temperature or voltage enters the shutdown range. After reaching the shutdown range, the controller will not function. You must resolve the problem and reboot the controller. If the problem is not resolved, it will shut down again.

Alarm conditions trigger an event message that displays in the Disk Array Administrator software window and in the event log. See *Displaying the Event Log* on page 5-1.

Table 7-1 shows the temperature and voltage thresholds for each alarm and what to do to resolve the problem.

Table 7-1. Alarm thresholds

| Alarm threshold | What to do when the alarm sounds |
|---|---|
| CPU temperature<br>Warning—0°C to 5°C and 65°C to 70°C<br>Shutdown—0°C and 70°C <0°C and >70°C | ■ Check the Disk Array Administrator software to confirm what the alarm means. See Chapter 3, *Accessing the Disk Array Administrator Software*.<br>■ Check the ambient temperature and lower it, if needed. Ambient temperature should be less than 45°C. |
| Onboard temperature<br>Warning—0°C to 5°C and 45°C to 50°C<br>Shutdown—0°C and 50°C <0°C and 50°C | ■ Same as above for the CPU temperature. |

Table 7-1. Alarm thresholds

| Alarm threshold | What to do when the alarm sounds |
|---|---|
| VCC voltage<br>Warning—5V -3.5% and +6.5%<br>Shutdown—5V -6.5% and +10% | ■ Check the Disk Array Administrator software to confirm what the alarm means. See Chapter 3, *Accessing the Disk Array Administrator Software*.<br>■ If it is a warning alarm, let the controller continue to operate.<br>■ If it is a shutdown alarm, turn off the power to the controller and send it for service. |
| 12V voltage<br>Warning—12V -8% and +8%<br>Shutdown—12V -10% and +10% | ■ Same as above for the VCC voltage. |

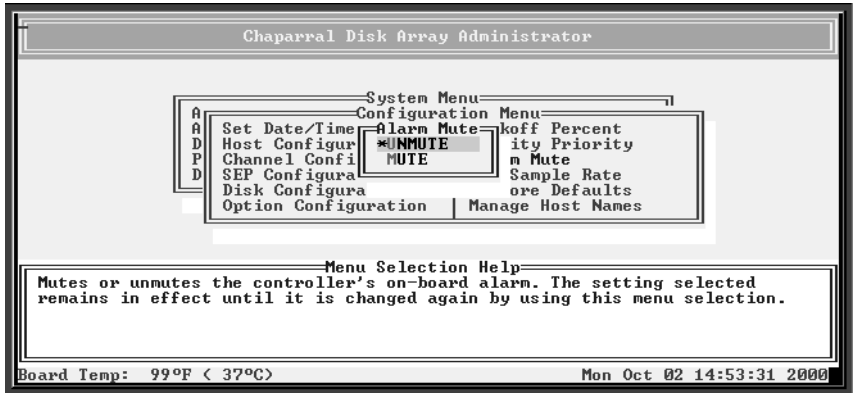
**To enable or disable the alarm**:

**1** From the System Menu, select **Configuration Menu** and press **Enter**.

The Configuration Menu screen displays.

**2** Select **Alarm Mute** and press **Enter**.

The Alarm Mute screen displays. The current setting is marked with an * next to it.




**3** Select the option you want and press **Enter**.

# Locking the Cache Setting

You can prevent host systems from using SCSI mode select commands to change the controller's write-back cache setting. Some operating systems disable write cache. If cache lock is enabled, the host cannot modify the cache setting. The default setting is disabled.

This option is useful in some environments where the host system disables the controller's write-back cache, resulting in degraded performance.

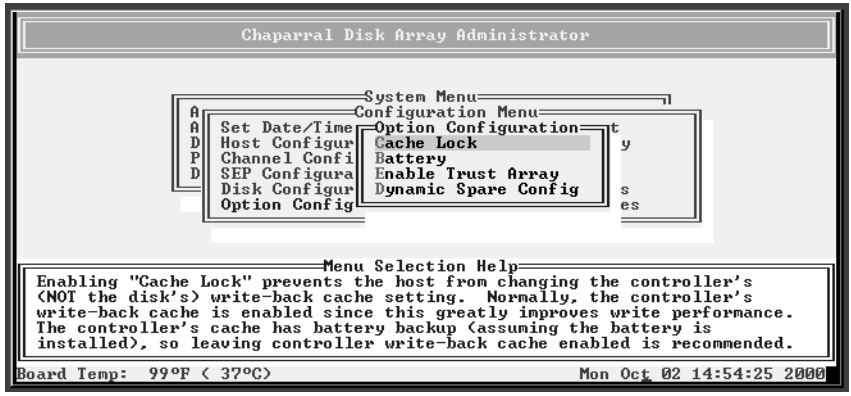
**To lock the cache setting:**

1. From the System Menu, select **Configuration Menu** and press **Enter**.

   The Configuration Menu screen displays.

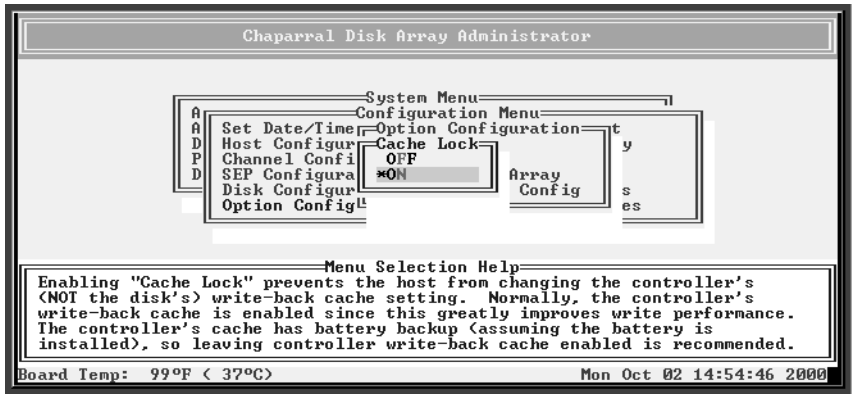
2. Select **Option Configuration** and press **Enter**.

   The Option Configuration screen displays.



**3** Select **Cache Lock** and press **Enter**.

The Cache Lock screen displays. The current setting is marked with an * next to it.




**4** Select the option you want and press **Enter**.

# Enabling and Disabling the Battery

If you are not using a battery in your controller, the controller will sound an alarm. To eliminate the alarm, you can disable the battery. The default setting is battery enabled.

**Note:** You should only disable the battery if you are running the controller with an uninterruptable power supply (UPS), so that you will not lose power to the controller.

If you disable the battery, the controller will *not* give any warnings, nor will it disable the write-back cache.

If you change this setting, you must reboot the controller for the change to take effect.

**To change the battery setting:**

**1** From the System Menu, select **Configuration Menu** and press **Enter**.

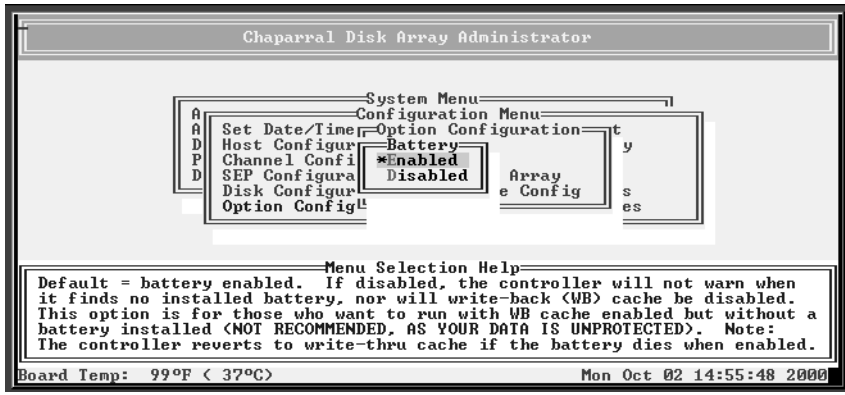
The Configuration Menu screen displays.

**2** Select **Option Configuration** and press **Enter**.

The Option Configuration screen displays.

**3** Select **Battery** and press **Enter**.

The Battery screen displays. The current setting is marked with an * next to it




**4** Select the option you want and press **Enter**.

# Changing the Utility Priority

You can change the priority at which all utilities (Verify, Reconstruct, Expand, Initialize, etc.) run when there are active I/O operations competing for the controller's CPU. The choices are:

- High (default)
- Medium
- Low

For example, select High if your highest priority is to get the array back to a fully fault-tolerant state. This causes heavy I/O with the host to be slower than normal. Select Low priority if streaming data without interruption, such as for a Web server, is more important than data redundancy. This allows the reconstruct or other utility to run at a slower rate with minimal effects on host I/O.

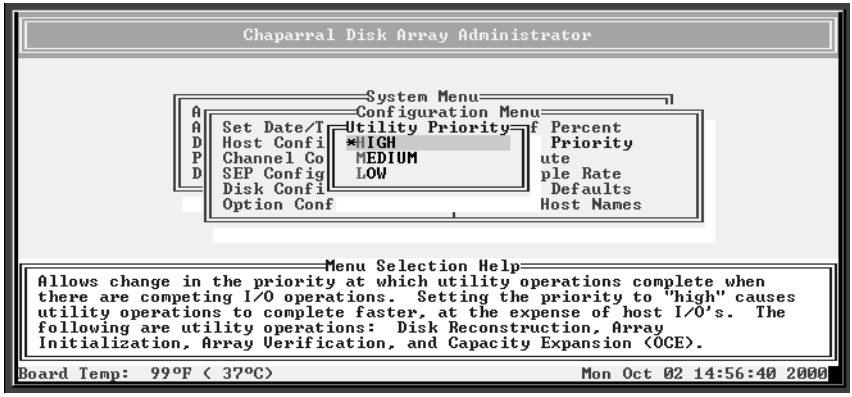
**To change Utility priority:**

1. From the System Menu, select **Configuration Menu** and press **Enter**.

   The Configuration Menu screen displays.

2. Select **Utility Priority** and press **Enter**.

   The Utility Priority screen displays. The current setting is marked with an * next to it.




3. Select the option you want and press **Enter**.

# Rescanning All Channels

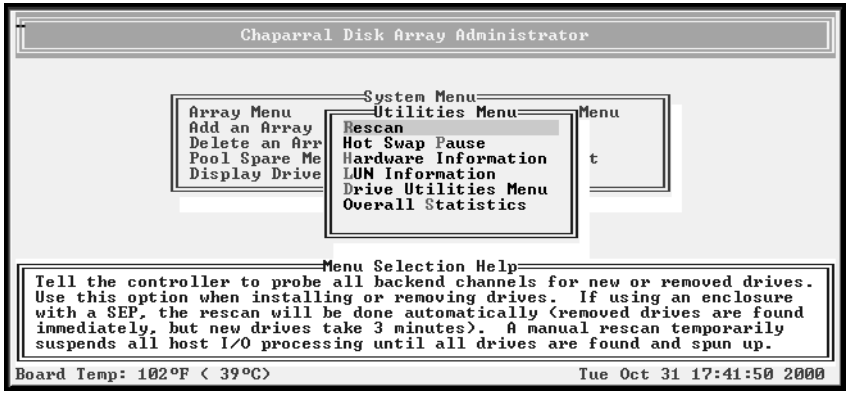
You can tell the controller to scan all disk channels for new or removed disk drives. You can use this option when you install or remove drives. The Rescan temporarily pauses all I/O processes and then resumes normal operation.

If you are using an enclosure with a SEP, the controller will perform a rescan automatically for you. With a SEP, the controller will detect removed drives almost immediately; however, installed drives will be detected after a three-minute delay. This delay is to allow the new drives to spin-up.

**To rescan all channels:**

1 From the System Menu, select **Utilities Menu** and press **Enter**.

The Utilities Menu screen displays.




2 Select **Rescan** and press **Enter**.

# Pausing I/O

Some drive enclosures allow you to remove and replace drives while SCSI bus activity continues; others do not. Refer to your enclosure documentation.

**Caution:** Pausing I/O halts active I/O to the host.

**Note:** If you are not sure that your enclosure supports hot swapping, use the Hot Swap Pause option before you remove or replace any drives in an array to ensure data integrity.

Hot Swap Pause suspends activity on all device channels used in the controller, thereby assuring data integrity on the connected drives and arrays.

**To pause I/O:**

1. From the System Menu, select **Utilities Menu** and press **Enter**.

   The Utilities Menu screen displays.

2. Select **Hot Swap Pause** and press **Enter.**

   The Bus Paused screen displays.


3. When you have replaced the drive, resume SCSI bus activity by pressing **Esc**.

**Caution:** *Do not* stay in the Hot Swap Pause mode for too long; otherwise, an operating system time-out may occur (the time varies according to the operating system). For example, in Windows NT the default limitation during I/O activity is 10 seconds.

# Restoring Default Settings

You can restore all of the controller's default settings. You may want to do this if the controller is not working properly and you cannot determine why. This lets you then change the settings that are critical to your configuration.

**Note:** Restoring defaults does *not* change any LUN zoning you have set up. The zoning information is stored on the array as metadata and is retained.

**To restore the default settings:**

1. From the System Menu, select **Configuration Menu** and press **Enter**.

   The Configuration Menu screen displays.

2. Select **Restore Defaults** and press **Enter**.

   The Restore Defaults screen displays. The selected option is marked with an * next to it.

   The system confirms that you want to make the change.

3. Select **Yes** and press **Enter** to make the change.

   The system confirms that the changes are made.

4. Press **Enter** to return to the Configuration Menu.

# Upgrading Firmware

You can upgrade the firmware for the controller.

Information regarding the latest release of firmware and firmware updates is available from the Chaparral Web site (www.chaparralnet.com/ and click on "Support"). Contact Chaparral technical support for firmware updates at (303) 845-3200 or e-mail to Support@chaparralnet.com

## Upgrading the Controller's Firmware

You use the Flash Utility to download new firmware (.fla file) for your controller, to auto-detect your VT-100/ANSI terminal baud rate, and to run onboard diagnostics. The Flash Utility is resident in the embedded firmware of the controller.

You access the Flash Utility using a computer with VT-100/ANSI terminal emulator software, such as HyperTerminal, connected to the controller through the serial RS-232 interface. The controller auto-detects the baud rate when you hold down the space bar on the computer while powering-on the controller. Valid baud rates are 9,600, 19,200, 38,400, 57,600 and 115,200. The default baud rate is 115,200 and is recommended to expedite the download process.

**To upgrade the controller's firmware:**

1. Call Chaparral technical support for information about downloading the firmware updates.

   See *Chaparral Technical Support* on page 9-1.

2. From the computer connected to the controller, access the Disk Array Administrator software.

   See Chapter 3, *Accessing the Disk Array Administrator Software*.

3. From the System Menu, select **Shutdown/Restart** and press **Enter**.

   The system confirms that you want to shut down.

4. Select **Yes** and press **Enter**.

   The system confirms that it has shut down.

5. Press **Enter** to reboot.

6. While the controller reboots, hold down the space bar on your keyboard.

   The Flash Utility screen displays.

```
Flash Utility

Local Memory Test Passed.
Configuration OK.

FLASH LOADER v5.012 - Oct 18 1999 16:40:31
Select Protocol
  1. FAST BINARY
  2. KERMIT
  3. XMODEM

  4. Run diagnostics
  5. Run bridge

  6. Utility Menu
  X. Reboot
```

7. Press the number on your keyboard that corresponds to the protocol you want to use to transfer the firmware upgrade file from your computer to the controller.

   We recommend using the KERMIT protocol.

   The system shows that it is ready to use KERMIT.

**8** Using your terminal emulator software, send the .fla file using KERMIT.

If you are using HyperTerminal, select **Transfer | Send File**, navigate to where the firmware update file is located, select it, and click **Open**. Select the same Protocol from the drop-down list as you selected from the Flash Utility screen. Click **Send**.

The file transfers. The system displays messages showing that it is flashing the code and rebooting the controller.

**Caution:** Do not interrupt the power when transferring the new firmware.

# 8

# Managing Disk Drives and Enclosures

The Disk Array Administrator software lets you control a variety of functions related to disk drives and SAF-TE Environmental Processor (SEP) enclosures connected to your controller.

- For drives, you can:
  - Display drive information (see page 8-2)
  - Clear metadata from a drive (see page 8-10)
  - Enable/disable write-back cache and display cache status (see page 8-5)
  - Enable/disable changes to SMART (see page 8-8)
  - Blink a drive LED (see page 8-9)
  - Take down a drive (see page 8-10)
  - Test a drive (see page 8-11)
- For SEP enclosures, you can:
  - Change the SEP LUN (see page 8-12)
  - Change additional SEP settings (see page 8-14)

## Managing Disk Drives

The Disk Array Administrator software lets you control a variety of functions related to disk drives. You should also refer to your disk drive or enclosure documentation for information about related functions.

# Displaying Drive Information

You can display two types of information about disk drives:

- A list of all drives connected to the controller
- The status of all drives in an array

## Displaying All Drives

You can display a list of all drives connected to the controller. The information includes:

- Channel
- SCSI target ID
- Size
- Manufacturer
- Model number
- Drive firmware revision

If any of the drives are members of an array, the following information may also display:

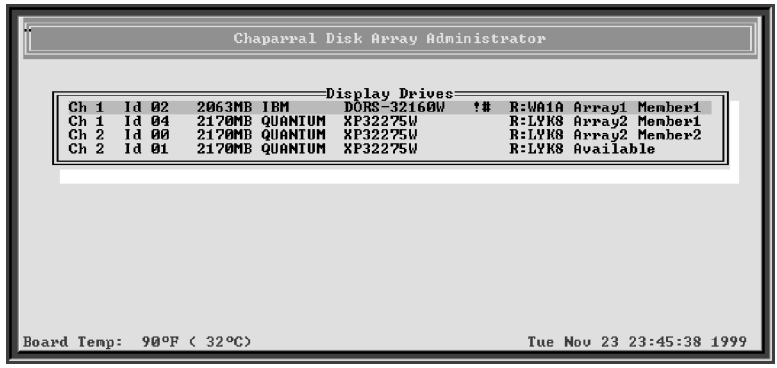
- Utility running—Expand, Verify, etc.
- Array number—this array's sequential position in the controller's array list
- Member number—this drive's sequential position in the array

Drives that are not members of any array are listed as Available. Drives that contain leftover metadata from a previous array are listed as Leftover. This situation can arise if drives are pulled and reinserted. To clear left over metadata, use the Clear Metadata function. See *Clearing Metadata from a Drive* on page 8-4.

**To display all drives:**

1 From the System Menu, select **Display Drives** and press **Enter**.

The Display Drives screen displays.




2 Press **Esc** to return to the System Menu.

## Viewing Drive Status

You view the status of the drives in an array, including the following information:

- Drive number—This drive's sequential position in the controller's drive list
- Drive status—Whether the drive is up or down
- Channel number—Back-end disk bus number
- Target ID
- Size—Size of the drive in MB
- Status—If a member of an array, this displays the array name and member number. If a spare, this displays the type of spare. If unused, displays Available. If drive was part of an array that no longer exists, displays Leftover.

**Note:** If a drive has failed or malfunctioned, it may not be listed.

**To view drive status:**

1. From the System Menu, select **Array Menu** and press **Enter**.

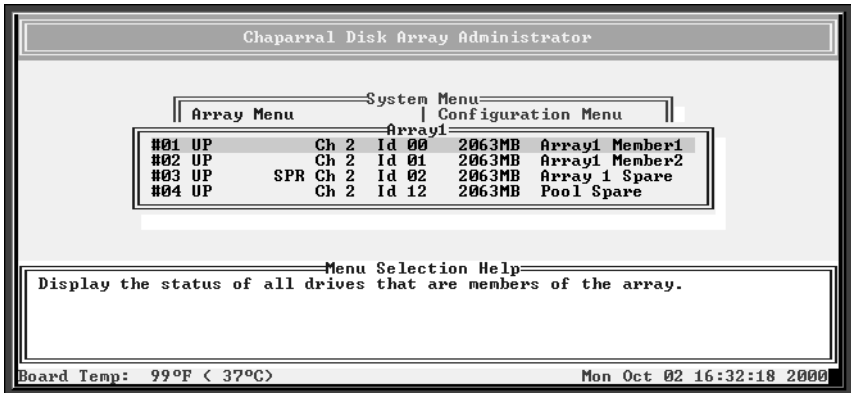
   The Select Array screen displays with a list of existing arrays.

2. Select the array you want and press **Enter**.

   The Array Menu screen displays.

3. Select **Drive Status** and press **Enter**.

   The Drive Status screen displays showing the drives that are members of the array and that are assigned as spares.




   Use the ↑ or ↓ arrow keys to scroll through the drives. These are the drives that are currently members of the array.

4. Press **Esc** to return to the Array Menu.

## Clearing Metadata from a Drive

All of the member drives in an array contain metadata in the first sectors of the drive. The controller uses the metadata to identify array members after restarting or changing controllers.

You can clear the metadata from a drive if you have a drive that was previously a member of an array. Drives in this state display Leftover in the Display Drives screen. After you clear the metadata, you can use the drive in an array or as a spare.

**To clear metadata from a drive:**

1. From the System Menu, select **Utilities Menu** and press **Enter**.

   The Utilities Menu screen displays.

2. Select **Drive Utilities Menu** and press **Enter**.

   The Drive Utilities Menu screen displays.

3. Select **Clear Metadata** and press **Enter**.

   The Select Drive screen displays showing drives that are not array members.

4. Select the drive you want and press **Enter**.

   You can now use this drive in an array or as a spare.

## Enabling and Disabling Write-back Cache

You can control the write-back cache setting for all of your disk drives at once. Changes take effect after the next rescan or reboot.

This can be set to ENABLE, DISABLE, or DON'T MODIFY (which means the controller should not change any drive's write-back cache settings). The default setting is DON'T MODIFY.

Typically, if your drives are part of an array, you do not want to turn on write-back cache on the drives. The controller is already using write-back cache to improve performance. Turning on write-back cache on the disk drive *may* improve performance in some cases, depending on the type of array and how you are using it.

Any disk drives with write-back cache enabled should be connected to an Uninterruptable Power Supply (UPS) in case of power failure. If the drives are not on a UPS and power is lost during disk writes, the array will lose any data in the disk's write-back cache.

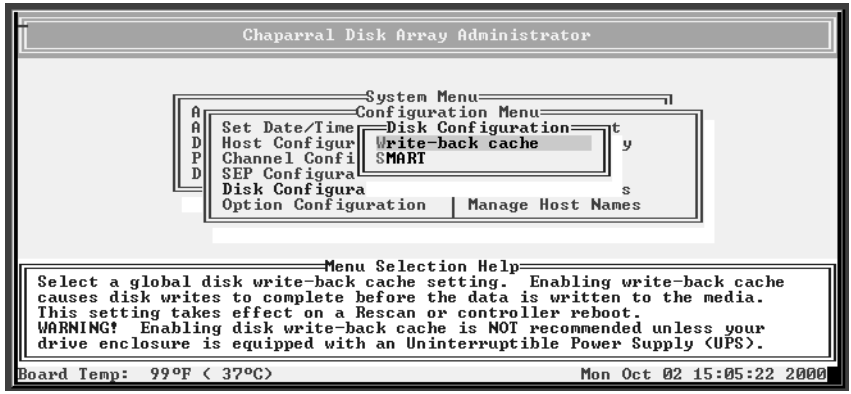
**To change the write-back cache setting:**

1. From the System Menu, select **Configuration Menu** and press **Enter**.

   The Configuration Menu screen displays.

**2** Select **Disk Configuration** and press **Enter**.

The Disk Configuration screen displays.




**3** Select **Write-back Cache** and press **Enter**.

The Write-back Cache screen displays. The current setting is marked with an * next to it.


**4** Select the option you want and press **Enter**.

**5** Reboot or rescan to have your changes take effect.

See *Rebooting the Controller* on page 7-1 or *Rescanning All Channels* on page 7-23.

## Displaying Disk Cache Status

You can display cache status of each disk drive. Any disk drives with write-back cache enabled should be connected to a UPS in case of power failure. If the drives are not on a UPS and power is lost during disk writes, the array will lose any data in the disk's write-back cache.

**To display disk cache status:**

1. From the System Menu, select **Utilities Menu** and press **Enter**.

   The Utilities Menu screen displays.

2. Select **Drive Utilities Menu** and press **Enter**.

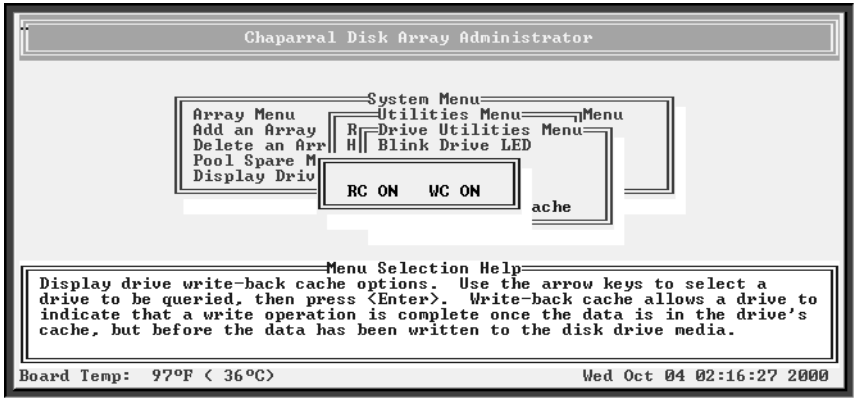
   The Drive Utilities Menu screen displays.


3. Select **Display Drive Cache** and press **Enter**.

   The list of drives screen displays.

4 Select a drive and press **Enter**.

The cache status screen displays showing the status of the read and write cache.




5 Press **Esc** to return to the Drive Utilities Menu.

## Enabling and Disabling SMART Changes

You can enable or disable the ability to change the Self-Monitoring, Analysis and Reporting Technology (SMART) settings for all drives connected to the controller. This can be set to ENABLE, DISABLE, or DON'T MODIFY (which means the controller should not change any drive's SMART settings). The default setting is DON'T MODIFY.

On most drives, SMART is disabled by default by the manufacturer. You may want to enable it if you want disk drives to be able to recover from errors on their own.

**To enable or disable SMART changes:**

1 From the System Menu, select **Configuration Menu** and press **Enter**.

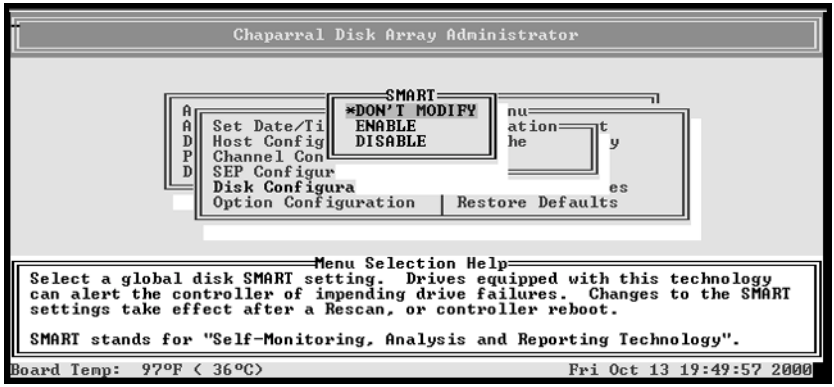
The Configuration Menu screen displays.

2 Select **Disk Configuration** and press **Enter**.

The Disk Configuration screen displays.

**3** Select **SMART** and press **Enter**.

The SMART screen displays. The current setting is marked with an * next to it.




**4** Select the option you want and press **Enter**.

**5** Reboot or rescan to have your changes take effect.

See *Rebooting the Controller* on page 7-1 or *Rescanning All Channels* on page 7-23.

## Blinking a Drive LED

You can blink the LED on a specific drive. The drive continues blinking its LED until you do one of the following:

- Press **Esc** before the Disk Array Administrator times out
- Repeat the blink LED command, which toggles the blink LED command off

**To blink a drive:**

**1** From the System Menu, select **Utilities Menu** and press **Enter**.

The Utilities Menu screen displays.

**2** Select **Drive Utilities Menu** and press **Enter**.

The Drive Utilities Menu screen displays.

3 Select **Blink Drive LED** and press **Enter**.

The Select Drive screen displays.

4 Select the drive you want and press **Enter**.

5 Press **Esc** to stop blinking the LED.

## Taking Down a Drive

**Caution:** This function is *only* for testing arrays and should *not* be used in normal operation.

The Down Drive function sets the status of a drive in a fault-tolerant array to down. This forces the controller to remove it from the array and marks the array as critical. At this point, you will be unable to down any additional drives in the array.

To make the drive display again, you must use Rescan. See *Rescanning All Channels* on page 7-23. After you rescan, you must clear the metadata from the drive before you can use it in an array or as a spare. See *Clearing Metadata from a Drive* on page 8-4.

**To take down a drive:**

1 From the System Menu, select **Utilities Menu** and press **Enter**.

The Utilities Menu screen displays.

2 Select **Drive Utilities Menu** and press **Enter**.

The Drive Utilities Menu screen displays.

3 Select **Down Drive** and press **Enter**.

The Select Drive screen displays showing drives that are array members.

4 Select the drive you want and press **Enter**.

The system confirms that you want to make the change.

5 Select **Yes** and press **Enter** to make the change.

## Testing a Drive

This function issues a Test Unit Ready (TUR) command to the selected disk. This just tells you that the drive can respond, but it still may not be functioning properly.

**To test a drive:**

1. From the System Menu, select **Utilities Menu** and press **Enter**.

   The Utilities Menu screen displays.

2. Select **Drive Utilities Menu** and press **Enter**.

   The Drive Utilities Menu screen displays.

3. Select **Test Unit Ready** and press **Enter**.

   The Select Drive screen displays.

4. Select the drive you want and press **Enter**.

   If the TUR was successful, TUR STATUS OK displays.

   If the TUR was not successful, a failure message displays.

5. Press **Esc** to return to the Drive Utilities Menu.

# Managing SAF-TE Enclosures

A SEP (SAF-TE Environmental Processor) is a SCSI device from which the RAID controller can inquire about environmental conditions such as temperature, power supply and fan status, and the presence or absence of disk drives. The RAID controller can also tell the SEP about RAID activities such as drive rebuilds and failed disk drives.

SAF-TE configuration settings are automatically enabled when G- and K-Series controllers are installed in an enclosure that contains a SEP. No changes are required to the default configuration settings to support SAF-TE.

You can control the following functions for SEP enclosures:

- Change the SEP LUN (see page 8-12)
- Change additional SEP settings (see page 8-14):
  - Polling interval
  - Temperature sensor status

- Slot update status
- Enclosure update status

## Changing the SEP LUN

SEP LUNs allow access to SEPs. A SEP LUN may be set to a value of 0-7, SOFT, or NONE. If set to SOFT, the SEP LUN is automatically assigned a value when the controller boots. The soft LUN value will be assigned to the first available LUN (starting from zero) that does not already have a hard (that is, a numeric) LUN assignment. NONE means that the SEP cannot be accessed via a LUN.

Note that if both a controller LUN and a SEP LUN are set to SOFT, the controller LUN will be assigned a value first.

You may want to change the SEP LUN if it conflicts with the LUN of another device.

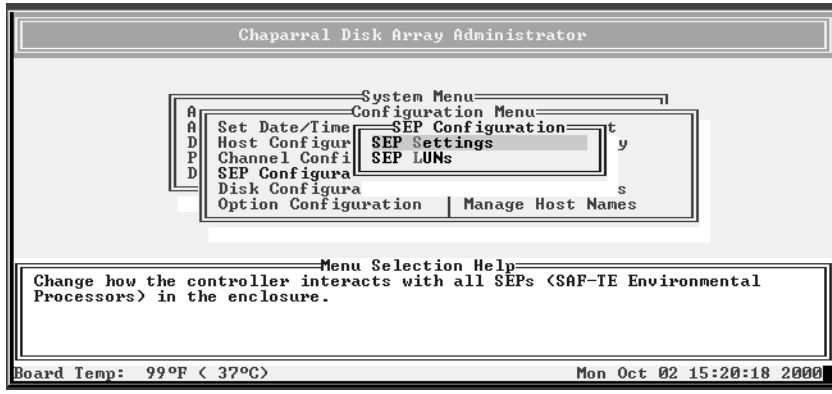
**To change the SEP LUN:**

1. From the System Menu, select **Configuration Menu** and press **Enter**.

   The Configuration Menu screen displays.

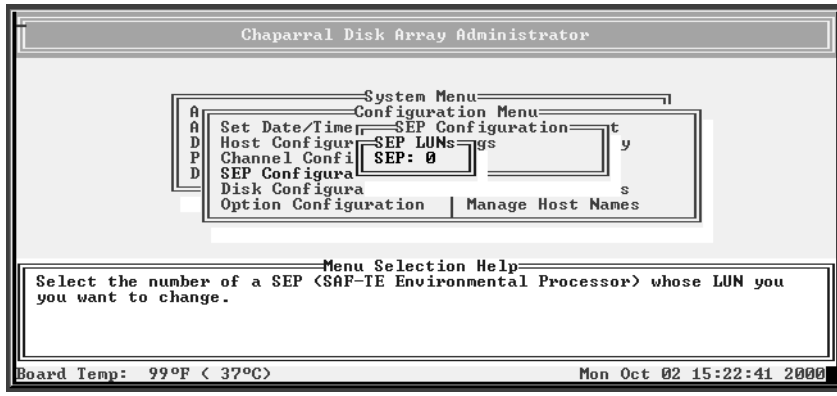
2. Select **SEP Configuration** and press **Enter**.

   The SEP Configuration screen displays.



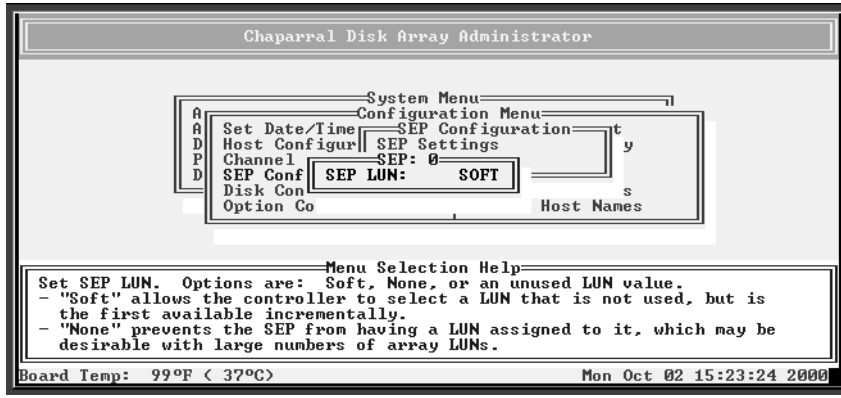
**3** Select **SEP LUNs** and press **Enter**.

The SEP LUNs screen displays.




**4** Select the LUN of the SEP you want and press **Enter**.

The SEP LUN screen displays.




**5** Select the option or number you want to use.

| To | Do this |
|---|---|
| Not assign the SEP a LUN | ■ Select **NONE** and press **Enter**. |
| Let the controller determine the SEP LUN each time it powers up | ■ Select **SOFT** and press **Enter**. This is the default setting. |

| To | Do this |
|---|---|
| Keep the same LUN for the SEP at all times | ■ Select the [LUN] you want to use and press **Enter**.<br>This can be any number from 0 to 7 that is not already in use. |

The system confirms that you want to make the change.

6 Select **Yes** and press **Enter** to make the change.

## Changing the Additional SEP Settings

You can change four additional SEP settings:

- Polling interval—This is the interval, in seconds, that the controller polls the SEPs for status changes. The default setting is 5 seconds.
- Temperature sensor—This controls whether the controller's onboard temperature sensor provides temperature information to the host along with the enclosure's temperature detected by the SEP. The default setting is OFF, which means that neither the controller nor the enclosure is providing temperature information to the host.
- Slot update status (Slot Flags)—This controls whether the controller sends commands to the SEP to update the status of each enclosure slot. The default setting is ON, which means that the controller does request status updates from the enclosure.
- Enclosure update status (Global Flags)—This controls whether the controller sends commands to the SEP to update the overall status of the enclosure. The default setting is OFF, which means that the controller does *not* request status updates from the enclosure.

**To change the SEP settings:**

1 From the System Menu, select **Configuration Menu** and press **Enter**.

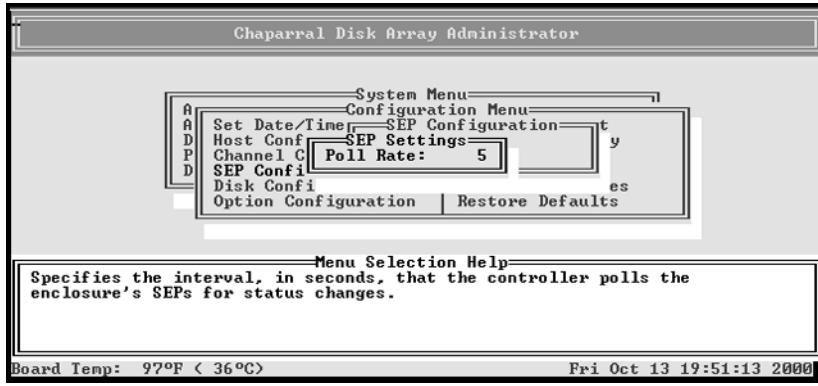
The Configuration Menu screen displays.

2 Select **SEP Configuration** and press **Enter**.

The SEP Configuration screen displays.

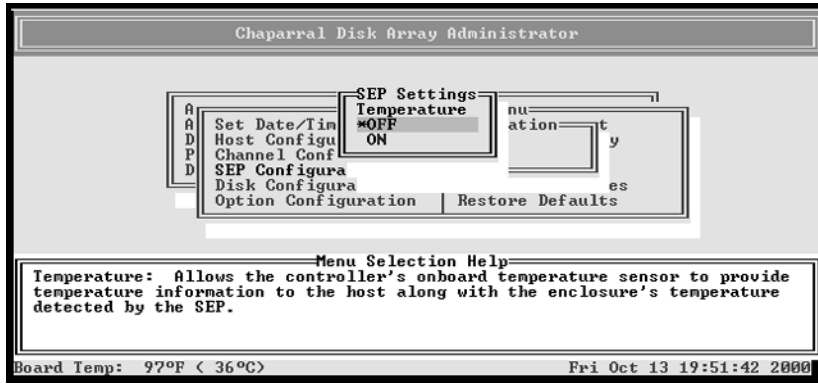
**3** Select **SEP Settings** and press **Enter**.

The Poll Rate screen displays.




**4** Enter the poll rate you want, in seconds, and press **Enter**.

The Temperature screen displays. The current setting is marked with an * next to it.



**5** Select the option you want and press **Enter**.

The Slot Flags screen displays. The current setting is marked with an * next to it


**6** Select whether you want the SEP to send slot status updates to the controller and press **Enter**.

The Global Flags screen displays. The current setting is marked with an * next to it.


**7** Select whether you want the SEP to send enclosure status updates to the controller and press **Enter**.

The system confirms that you want to make the change.

**8** Select **Yes** and press **Enter** to make the change.

❒

# 9

# Troubleshooting

## Chaparral Technical Support

For assistance configuring and using your Chaparral product, contact your authorized distributor or Chaparral technical support at: support@chaparralnet.com. Resolutions to common problems you may encounter are described in the following sections.

## Terminal Emulator and COM Port Problems

**Problem: Screen continuously puts out garbage characters.**

The likely cause of this problem is a baud rate mismatch between the terminal emulator and the controller. The default baud rate is 115,200. Follow these steps if you set your terminal emulator to this rate and still get garbage characters:

1. If you are able, shut down the controller.

   See *Rebooting the Controller* on page 7-1. If you are not able to shut down the controller, continue with step 2.

2. Turn OFF the power to the enclosure containing the controller.
3. Press the spacebar of your terminal emulator.
4. Turn ON the power while continuing to press the spacebar. This will allow the controller to autodetect the baud rate setting.
5. When the Flash Utility appears, select option **5** to continue to boot the controller.

**Note:** Some terminal emulators don't immediately change to the new baud rate settings, and you have to exit and restart the emulator to use the new settings.

**Problem: Nothing is displayed on the terminal emulator screen.**

The probable cause of this problem is a bad RS-232 cable connection or swapped transmit/receive lines. If the cable is properly connected on both ends, try a *null modem* adapter that will reverse the RS-232 transmit and receive signals. The need for a null modem adapter depends on both your enclosure and the RS-232 cable you are using.

**Problem: Screen is updated, but won't respond to keystrokes.**

Disable hardware flow control on the terminal or terminal emulator. The controller supports XON/XOFF flow control and works properly in most cases with no flow control.

**Problem: Screen looks correct, but clock is not being updated.**

Check to be sure that enclosure containing the controller is still powered on. If you are using XON/XOFF, press the **Ctrl** key and the **Q** key simultaneously.

**Problem: Screen is updated and menus appear right, but boxes around menus look incorrect.**

Try a different font in your terminal emulator program, such as Terminal. If you cannot find a font that looks correct, set ASCII Display to **Yes** in the Display options item of the Configuration menu.

# Array Problems

**Problem: Array is much smaller than it should be.**

The backoff percent may be set higher than 1%, which is causing the array to be much smaller than the full size of its member disks.

**Note:** *We strongly recommend that you leave the backoff percent at 1%.*

The setting backs off or reduces the capacity of the array by the given percentage. The backoff percentage helps when you assign spares by compensating for the minor capacity differences that occur between vendors. For example, two 18-GB drives from two different vendors may differ in capacity by 100 MB. With a back-off of 0%, you would not be able to replace an array member's slightly larger 18-GB drive with a smaller 18-GB drive. If you intend to only use identical drives from the same vendor, then you can use a back-off of 0%.

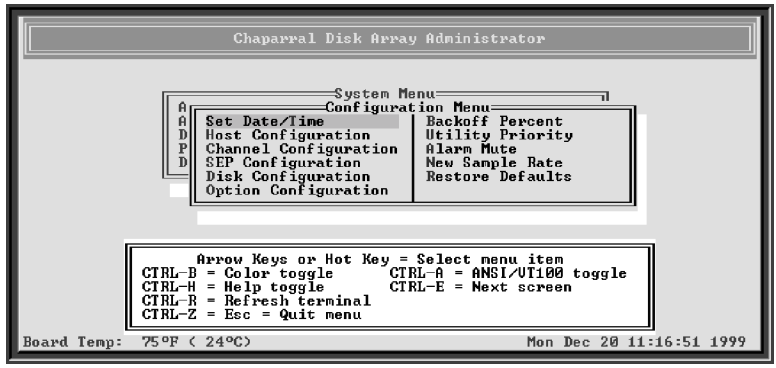
The default setting is 1% backoff. This default allows you to easily work with drives that have the same nominal capacity, but different actual capacities. The backoff percentage affects all arrays created on the controller after you set the percentage.

If the drives in an array are not equal in size, the array capacity in a RAID-5 array is based on the smallest member's capacity. The backoff percentage is then backed off the capacity from that amount.

**To change the backoff percentage:**

1. From the System Menu, select **Configuration Menu** and press **Enter**.

   The Configuration Menu displays.




2. Select **Backoff Percent** and press **Enter**.

   The Backoff Percent screen displays.

3. Enter the backoff percent you want to use and press **Enter**.

   Enter the percentage as three digits in the following format: 00.0%. The default is 01.0%.

# Host SCSI Channel Problems

**Problem: The host SCSI BIOS scan displays "Device name not available."**

The controller is properly connected, but no arrays have been created. Use the Disk Array Administrator to create an array and reboot the host system.

**Problem: The host SCSI BIOS scan hangs.**

Check that termination is set correctly in the Configuration Menu and the drive enclosure. Check that the device ID set in the Disk Array Administrator does not

conflict with any other devices on the host SCSI channel. If you have a long SCSI cable, try a different or shorter cable.

**Problem: Only one array is displayed during host SCSI BIOS scan.**

Check to assure that LUN support is enabled. Most SCSI host adapters, such as the AHA-2940U2W, ship with LUN support disabled by default. Use Display Array Status to check the LUN assignment for each array. If LUN 0 is not assigned to an array, or some other LUN numbers are skipped, use the Change LUN Assignment option for each array until you have LUN numbers starting at 0 with no LUNs skipped. You must reboot the host system to recognize the new LUN assignment.

**Problem: All arrays are displayed during host SCSI BIOS scan, but only one array is seen by the operating system.**

SCSI drivers for some operating systems require a parameter switch to enable LUN support. For example, the NetWare driver, *aic7870.dsk*, requires the driver parameter LUN_ENABLE=FF (in *startup.ncf*) to scan for all LUN's. Check the driver documentation for your host SCSI channel. You may also need to compact the LUN mapping.

# Device SCSI Channel Problems

**Problem: Not all drives connected to the controller device channels are displayed during boot, or the controller hangs during display of connected drives and never reaches the Disk Array Administrator screen.**

Check your array enclosure's documentation to be sure that the enclosure is properly configured for use with a RAID controller. If your enclosure supports removable drives, check the drive shuttles to be sure that the power connectors, SCSI connectors, and ID connectors are properly seated. Check termination and ID assignment. If you have enabled Ultra/Ultra2 SCSI on any device channels, try disabling it.

**Note:** Check the controller termination settings for all channels.

# Problems During Bootup

The following sections describe problems you might encounter during Power On Self-Test (POST) or during bootup and explain how to resolve those problems. POST shows problems related to the processor, logic, and memory.

**Problem: Controller failed the onboard memory test.**

When this failure occurs, it means the internal CPU memory failed. Replace the controller to correct the problem.

**Problem: System hangs at `Loading Bridge` during BFLU Loader Menu.**

Reflash the firmware to ensure you are using the latest version. See *Upgrading Firmware* on page 7-26. If you cannot update the firmware or if the updated firmware does not correct the problem, replace the controller.

**Problem: One of the POST diagnostic test failed.**

Contact Chaparral technical support.

**Problem: The system hangs at `CT_srv starting`.**

Follow these steps to resolve the problem:

1. Check the disk and host channels to make sure they are properly terminated.
2. Verify that there are not any SCSI address conflicts.
3. Check the enclosure to make sure everything is properly connected.
4. If the enclosure and the drive work properly, replace the controller.

**Problem: The system hangs during a drive scan.**

Follow these steps to resolve the problem:

1. Check the enclosure to make sure everything is properly connected.
2. Remove and replace the drive that failed the scan.
3. If the enclosure and the drive work properly, replace the controller.

# Controller Problems

**Problem: The controller's STATUS LED does not turn on. (The controller's STATUS LED is on the controller board and is only visible if you open your enclosure or if it is connected to a status LED on your enclosure.)**

Check that 5V power is being applied to the controller. Check the RS-232 interface for power-on initialization and for diagnostics errors. Check the Disk Array Administrator for outstanding events.

**Problem: The controller's STATUS LED is on but there is no RS-232 display. (The controller's STATUS LED is on the controller board and is only visible if you open your enclosure or if it is connected to a status LED on your enclosure.)**

Check that the RS-232 cable is the correct type (direct connect). Check that the terminal emulation utility on the computer system is properly configured. See *Accessing the Disk Array Administrator Using the RS-232 Serial Port* on page 3-1.

**Problem: The controller reports a SDRAM memory error.**

Check that the SDRAM DIMM is fully seated in the connector and the latches are fully engaged into the DIMM notches. Check that the SDRAM is from the Chaparral approved vendor list. See the Chaparral technical support web site for the latest updated information.

**Problem: The controller reports a Battery error.**

Verify that the 3-cell NiMH battery pack is being used. The battery packs from other Chaparral external RAID controllers, such as the G6322, are not compatible. You will not damage the battery pack or the controller by using the wrong battery, but the controller will not operate properly. Check the battery pack cable for breaks. Ensure that the battery connector is fully seated in the controller connector mate.

# Warning And Error Events

There are a number of conditions that trigger warning or error events, activate the alarm, and may affect the state of the STATUS and FAULT LEDs. The alarm or buzzer sounds mainly when the Disk Array Administrator displays a warning or error event. The controller's STATUS LED is on the controller board and is only visible if you open your enclosure or if it is connected to a status LED on your enclosure. The FAULT LED is only visible if it is connected to a fault LED on your enclosure.

The alarm will silence when you acknowledged the event by pressing **Esc**. The events in these categories are listed below.

## Warnings

Warning events let you know that something related to the controller or an array has a problem. You should correct the problem as soon as possible. Table 9-1 below defines each warning event and recommends the action you should take.

Table 9-1. Warning events

| Event | Definition | Recommended Action |
|---|---|---|
| BATT FAIL INFO | A warning condition in the battery pack and/or charging interface has been detected. | Replace the battery. Refer to the enclosure's documentation. |
| REPLACE BATTERY | The battery is approaching its 3-year life span. | Replace the battery. |
| ARRAY CRITICAL | One or more drives were downed and the array is online but no longer fault tolerant. | Add a spare to the array or to the spare pool. Then replace the bad drives. See *Adding a Dedicated Spare* on page 6-2 or *Adding a Spare to the Spare Pool* on page 6-5. |
| DRIVE DOWN | An error occurred with the drive and it was downed, removing it from the active array. | Add a spare to the array or to the spare pool. Then replace the bad drive. See *Adding a Dedicated Spare* on page 6-2 or *Adding a Spare to the Spare Pool* on page 6-5. |
| SPARE UNUSABLE | The drive still contains metadata that must be cleared. | Clear the metadata from the spare drive. See *Clearing Metadata from a Drive* on page 8-4. |
| SMART EVENT | A disk drive IEPC (informational exceptions page control) predictive failure message was received. No actions by the controller are taken on the drive for these events. | Run diagnostics available from your operating system on the affected drive. Replace the drive, if necessary. |

Table 9-1. Warning events (Continued)

| Event | Definition | Recommended Action |
|---|---|---|
| ARRAY OFFLINE | More than one drive in a RAID 0 or volume set went down bringing the array to an offline state. This array is no longer accessible by the host. | Replace the bad drive and restore the data from backup. |
| VOLT/TEMP WARN | The analog to digital convertor monitored a temperature and/or voltage in the warning range. | Check that the controller's fan is running. Check that the ambient temperature is not too warm. See *Specifications* on page 1-7. |
| UNWRITABLE CACHE | The SDRAM cache has battery backed up data, and the arrays assigned to this data are not present. | Either determine which drives are missing and reinstall them, or select Yes when asked if you want to discard this data. |
| SDRAM CORR ECC | A correctable single bit SDRAM ECC error. | If this error occurs frequently, replace the memory. |

## Errors

Error events let you know that something related the enclosure, controller, or disk drives has failed and requires immediate attention. Table 9-2 defines each error event and recommends the action you should take.

Table 9-2. Error events

| Event | Definition | Recommended Action |
|---|---|---|
| VOLT/TEMP FAIL | The analog to digital convertor monitored a temperature and/or voltage in the failure range. | Check that the controller's fan is running. Check that the ambient temperature is not too warm. See *Specifications* on page 1-7. |
| ENCLOSURE FAIL | Enclosure-specific general purpose IO trigger a failure condition. | Check the status of the enclosure. Refer to the enclosure's documentation. |
| BATTERY FAILED | A failure in the battery pack and/or charging interface has been detected. | Replace the controller's battery. |

Table 9-2. Error events (Continued)

| Event | Definition | Recommended Action |
|---|---|---|
| DISK CHAN FAILED | An error has occurred in communicating on the disk channel. | Check the cables on the channel. Check the termination on the disk channel. |
| SDRAM UNCORR ECC | A noncorrectable multiple bit SDRAM ECC error. | Reseat the memory. If the problem continues, replace the memory. |

# Using the Loader Diagnostics Menu

If you have any diagnostic errors, contact Chaparral technical support.

# Using the Loader Utility Menu

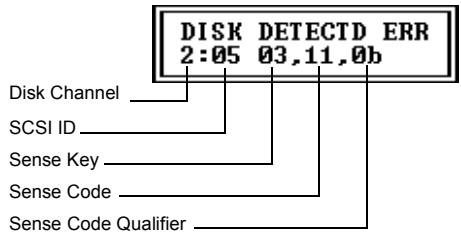
If you have any diagnostic errors, contact Chaparral technical support.

# Understanding SCSI Errors

The event log includes SCSI errors reported by SEPs and disk drives on your system. If you see these errors in the event log, the information below may assist you. For more information about viewing the event log, see *Displaying the Event Log* on page 5-1.

## Disk Errors

If a disk detects an error, it reports the error, which is recorded in the event log. The figure below shows an example of a disk detected error.



Using the information in Table 9-3 and Table 9-4 below, you can see that this is a medium error, unrecovered read error—recommend reassignment.

Table 9-3 lists some of the most common SCSI sense key descriptions (in hexadecimal). Table 9-4 lists the descriptions for the most common sense codes (ASC) and sense code qualifiers (ASCQ), all in hexadecimal. See the *SCSI Primary Commands - 2 (SPC-2) Specification* for a complete list of ASC and ASCQ descriptions.

Table 9-3. Sense key descriptions

| Sense Key | Description |
|---|---|
| 0h | No sense |
| 1h | Recovered error |
| 2h | Not ready |
| 3h | Medium error |
| 4h | Hardware error |
| 5h | Illegal request |
| 6h | Unit attention |
| 7h | Data protect |
| 8h | Blank check |
| 9h | Vendor-specific |
| Ah | Copy aborted |
| Bh | Aborted command |
| Ch | Obsolete |
| Dh | Volume overflow |
| Eh | Miscompare |
| Fh | Reserved |

Table 9-4. ASC and ASCQ descriptions

| ASC | ASCQ | Descriptions |
|---|---|---|
| 0C | 02 | Write error—auto reallocation failed |
| 0C | 03 | Write error—recommend reassignment |
| 11 | 00 | Unrecovered read error |

Table 9-4. ASC and ASCQ descriptions (Continued)

| ASC | ASCQ | Descriptions |
|---|---|---|
| 11 | 01 | Read retries exhausted |
| 11 | 02 | Error too long to correct |
| 11 | 03 | Multiple read errors |
| 11 | 04 | Unrecovered read error—auto reallocate failed |
| 11 | 0B | Unrecovered read error—recommend reassignment |
| 11 | 0C | Unrecovered read error—recommend rewrite the data |
| 47 | 00 | SCSI parity error |
| 48 | 00 | Initiator detected error message received |

## Disk Channel Errors

Disk channel errors are similar to disk detected errors, except they are detected by the controller, instead of the disk drive. Some disk channel errors are displayed as text strings, others are displayed as hexadecimal codes.

The example below shows a disk channel error displaying the hexadecimal code. See Table 9-5 below for a list of error code descriptions. Most disk channel errors are informational since the controller issues retries to correct any problem. Errors that cannot be corrected with retries will result in another critical event describing the affected disk array (if any).


Table 9-5. Disk Channel Error Codes

| Error Code | Description |
|---|---|
| 04 | Data overrun or underrun occurred while getting sense data |
| 05 | Request for sense data failed |
| 20 | Selection timeout (displayed as "Sel Timeout") |
| 21 | Controller detected an unrecoverable protocol error on the part of the target |
| 22 | Unexpected bus-free condition (displayed as "Unex Bsfree") |
| 23 | Parity error on data received from a target (displayed as "Parity Err") |
| 24 | Data overrun or underrun has been detected (displayed as "Data OvUnRn") |
| 30 | Target reported busy status (displayed as "Device Busy") |
| 31 | Target reported queue full status (displayed as "Queue Full") |
| 32 | Target has been reserved by another initiator |
| 40 | Controller aborted an I/O request to this target because it timed out (displayed as "I/O Timeout") |
| 41 | I/O request was aborted because of a channel reset |
| 42 | I/O request was aborted because controller's decision to reset the channel |

Table 9-5. Disk Channel Error Codes (Continued)

| Error Code | Description |
|---|---|
| 43 | I/O request was aborted because of third-party channel reset (displayed as “Abort 3PRST”). |
| 44 | Controller decided to abort I/O request for reasons other than bus or target reset |
| 45 | I/O request was aborted because of target reset requested by controller |
| 46 | Target did not respond properly to abort sequence |
| 4B | I/O aborted due to operating mode change (such as LVD to SE or SE to LVD) (displayed as “Abort MdChg”). |
| 50 | Disk channel hardware failure (displayed as "DskChn Fail") This may be the result of bad termination or cabling. |

## Voltage and Temperature Errors and Warnings

Most voltage and temperature errors occur due to the enclosure. Check the enclosure configuration first.

# A

# Array Basics

Chaparral's RAID controllers let you set up and manage disk arrays. A *disk array* is a group of disks that appears to the system as a single virtual disk. This is accomplished through software resident in the RAID controller. *RAID* (Redundant Array of Independent Disks) refers to disk arrays in which part of the array storage capacity may be used to store redundant information. The redundant information lets you restore user data if a disk in the array fails.

The host system views the controller as a single SCSI disk drive. It is actually an array of physical disks behind a RAID controller. The controller is managed by software to appear as a single very large physical disk. Depending on the array type, the virtual disk has advantages in fault-tolerance, cost, performance, or a combination of these. This section explains the different array types and the disk requirements for each type.

## Array Types

Array types are defined by their RAID level, a number from 0 through 5 (a higher RAID level does not necessarily indicate a higher level of performance or fault-tolerance). Chaparral's RAID controllers let you create the types of arrays that have proven to be the most useful for RAID applications: RAID 0, 1, 1/0 (also known as mirrored), 3, 4, 5, 50, and Volume Sets.

### RAID 0 (Striped Disks)

In a RAID 0 array, data is distributed, or *striped*, across the disks in the array. The array appears to the server as one large disk with a capacity approximately equal to the combined capacity of the physical disks. Because multiple reads and writes can be handled in parallel, the input/output performance of the array is much better than that of a single physical disk.

RAID 0 arrays do not store redundant data, so they are not true RAID applications. If one disk fails, the entire array fails and all array data is lost. The fault-tolerance of a RAID 0 array, therefore, is less than that of any single disk in the array. The term RAID 0 is widely used for these arrays, however, because they are conceptually similar to true RAID applications.

## RAID 1, RAID 1/O (Mirrored Disks)

In RAID 1 and RAID 1/0 arrays (commonly called *mirrored arrays*) disks are paired, with both disks in a pair containing the same data. When data is written to a mirrored array, it is written twice—once to each disk in the pair. A RAID 1 array has only one set of paired disks. A RAID 1/0 array has multiple pairs, across which data is striped.

The read performance of RAID 1 arrays can be much better than that of a single disk, while the write performance is slightly lower. In RAID 1/0 arrays, both read performance and write performance are better than those of a single disk.

A mirrored array is also highly reliable, because both disks *in a pair* must fail for the array to fail. In an array with five pairs of mirrored disks, for example, the array can maintain its integrity even if five disks fail—as long as each pair is left with one good disk. The main disadvantage of a mirrored array is its cost. Because all disks must have a twin, you must use twice the number of disks that actually contribute to the array capacity. In an eight-disk array, for example, you have only four disks of usable capacity.

## RAID 3

RAID 3 arrays contain redundant information in the form of parity data, which is calculated block-by-block for all user data. The user data is distributed across all but one of the disks in the array. The parity data is written exclusively to the *parity disk* (also known as the *check disk*). In the event of a disk failure, the data can be reconstructed from corresponding data stripes on the remaining disks in the array.

RAID 3 provides excellent I/O performance for applications that require high data transfer rates such as image processing, video processing, scientific data collection, batch data processing, or sequential reads and writes.

RAID 3 is not well suited for transaction processing or other applications that require simultaneous reads and writes.

## RAID 4

RAID 4 is similar to RAID 3 in that the redundant information is achieved in the form of parity data. The user data is distributed across all but one of the disks. The controller uses a single, dedicated parity drive for data protection. The main difference is that RAID 3 usually synchronizes writes to its disks, while RAID 4 can send data to its disk independently.

RAID 4 is best suited for transaction processing applications that require high read requests, but not write requests such as inquires rather than updates.

RAID 4 is not recommended for I/O intensive applications that require high data transfer rates.

## RAID 5

RAID 5 arrays contain redundant information in the form of parity data, which is calculated block-by-block for all user data. The parity information is distributed across the disks in the array and occupies the equivalent capacity of about one disk. Data is interspersed with the parity information. If one disk in the array fails, the data on the failed disk can be reconstructed from the parity data and user data on the remaining disks. Two disks must fail before the entire array fails.

The read performance of a RAID 5 array is excellent—comparable to that of a RAID 0 array. Write performance is lower than that of a RAID 0 array, because write operations involve calculating and writing new parity data as well as writing the new user data.

## RAID 50

RAID 50 arrays are made up of two or more RAID 5 arrays, across which data is striped. RAID 50 arrays contain redundant information in the form of parity data, which is calculated block-by-block for all user data. As in a RAID 5 array, the parity information is distributed across the disks in the array and occupies the equivalent capacity of one disk per RAID 5. Data is interspersed with the parity information. If one disk in the array fails, the data on the failed disk can be reconstructed from the parity data and user data on the remaining disks. Two disks in one RAID 5 subset must fail before the entire array fails.

The read performance of a RAID 50 array is excellent—better than a RAID 5 array—along with better data protection. Write performance is lower than that of a RAID 0 array, because write operations involve calculating and writing new parity data as well as writing the new user data.

## Volume Sets

A volume set is the ability to create a host-accessible LUN that maps to a single disk in the array, similar to JBOD. Volume sets are non-redundant and have a capacity slightly less than the physical disk they are created from. Volume sets are useful if you have a single disk available and you don't want to use it as a spare.

**Note:** For more information on RAID levels, see *The RAIDbook: A Source Book for RAID Technology*, published by the RAID Advisory Board (St. Peter, Minnesota: February, 1996).

# Comparing RAID Levels

Table A-1 illustrates the differences between the different RAID levels:

Table A-1. Comparing RAID Levels

| RAID Level | Min No. of Drives | Description | Strengths | Weaknesses |
|---|---|---|---|---|
| RAID 0 | 2 | Data striping without redundancy | Highest performance | No data protection—one drive fails, all data is lost |
| RAID 1 | 2 | Disk mirroring | Very high:<br>• Performance<br>• Data protection<br>• Minimal penalty on write performance | High redundancy cost overhead—because all data is duplicated, twice the storage capacity is required |
| RAID 2 | n/a | No practical use | Previously used for RAM error environments correction (known as Hamming Code) and in disk drives before the use of embedded error correction | No practical use—same performance can be achieved by RAID 3 at lower cost |

Table A-1. Comparing RAID Levels (Continued)

| RAID Level | Min No. of Drives | Description | Strengths | Weaknesses |
|---|---|---|---|---|
| RAID 3 | 3 | Block-level data striping with dedicated parity drive | Excellent performance for large, sequential data requests | Not well-suited for transaction-oriented network applications; single parity drive does not support multiple, concurrent and write requests |
| RAID 4 (Not widely used) | 3 | Block-level data striping with dedicated parity drive | Data striping supports multiple simultaneous read requests | Write requests suffer from same single parity-drive bottleneck as RAID 3; RAID 5 offers equal data protection and better performance at same cost |
| RAID 5 | 3 | Block-level data striping with distributed parity | Best cost/performance for transaction-oriented networks; very high performance and data protection; supports multiple simultaneous reads and writes; can also be optimized for large, sequential requests | Write performance is slower than RAID 0 or RAID 1 |
| RAID 50 | 6 | Combination of RAID 0 (data striping) and RAID 5 with distributed parity | Better random performance and data protection than RAID 5 | Lower storage capacity than RAID 5 |

Table A-1. Comparing RAID Levels (Continued)

| RAID Level | Min No. of Drives | Description | Strengths | Weaknesses |
|---|---|---|---|---|
| RAID 1/0 Also known as mirrored | 4 | Combination of RAID 0 (data striping) and RAID 1 (mirroring) | Highest performance and data protection (can tolerate multiple drive failures) | High redundancy cost overhead; because all data is duplicated, twice the storage capacity is required; requires minimum of four drives |
| Volume Sets | 1 | Non-RAID, non-striped mapping to a single drive (similar to JBOD) | Ability to use a single drive to store additional data | Not protected, lower performance (not striped) |

# Mixing Disks from Different Manufacturers or with Different Capacities

An array can contain different models of SCSI disks, even disks with different capacities; for example, an array can include a 4-GB disk and a 9-GB disk. If you mix disks with different capacities, the smallest disk determines the logical capacity of all other disks in the array, regardless of RAID level. For example, if a RAID 0 array contains one 4-GB disk and four 9-GB disks, the capacity of the array is equivalent to about five 4-GB disks. To maximize disk capacity, use disks of similar size.

# Mixing Disks on Different RAID Controller Channels

The G5312 and K5312 RAID controllers have two device channels: 1 and 2; the G7313 and K7313 have three device channels: 0, 1, and 2. An array can consist of disks on different channels of the same RAID controller.

# Glossary

**Address—**An address is a data structure or logical convention used to identify a unique entity, such as a particular process or network device.

**Arbitrated loop physical address (AL_PA)—**An AL_PA is a 1-byte value used in an arbitrated loop topology. This value is used to identify L_Ports. The value then becomes the last byte of the address identifier for each public L_Port on the loop.

**Bus—**See Channel.

**Channel—**A channel is a common physical path composed of wires or other media, across which signals are sent from one part of a computer to another. A channel is a means of transferring data between modules and adapters, or between an adapter and SCSI devices. A channel topology network consists of a single cable trunk that connects one workstation to the next in a daisy-chain configuration. All nodes share the same medium, and only one node can broadcast messages at a time.

**Fabric—**Fabric refers to a switched topology, which is one of the three FC topologies. Fabric elements, which are responsible for frame routing, interconnect various N_Ports or NL_Ports. Depending on vendor support, fabric switches may be interconnected to support up to 16 million N_Ports on a single network.

**Fibre—**Fibre is a generic FC term that refers to all transmission media types specified in the FC Physical Layer standard (FC-PH), such as optical fiber, copper twisted pair, and copper coaxial cable.

**Fibre channel (FC)—**FC is a bidirectional, point-to-point serial data channel, structured for high-performance capability. In the physical sense, an FC is an interconnection of multiple communication points, called N_Ports, by a switching network (fabric). FC transports incoming data from devices by reading the buffer information, packaging it, and sending the information across the fabric. Although FC is a generalized transport mechanism that has no protocol of its own or native I/O command set, it can transport any existing upper level protocol such as SCSI and IP. FC offers high-speed data transfer rates up to 1 Gbps. FC is most commonly used to connect clustered servers to storage systems. ANSI has developed standards for FC.

**FC adapter—**An FC adapter is a printed circuit assembly that translates data between the FC host processor's internal bus and FC link.

**FC Arbitrated Loop (FC-AL)—**FC-AL is one of three FC topologies in which ports use arbitration to establish a point-to-point circuit. Arbitrated loops allow multiple ports to be connected serially in a single loop. Up to 126 NL_Ports and 1 FL_Port can be configured in a unidirectional loop. Ports arbitrate for access to the loop based on their AL_PA. Ports with lower AL_PAs have higher priority than ports with higher AL_PAs.

**FC device—**A device that uses FC communications is referred to as an FC device.

**FC port—**An FC port is the opening at the back of a router that provides a fiber optic connection between the FC adapter and FC host.

**FC protocol for SCSI (FCP)—**FCP defines an FC mapping layer (FC-4) that uses FC-PH services to transmit SCSI command, data, and status information between a SCSI initiator and SCSI target. FCP enables transmission and receipt of SCSI commands, data, and status across the FC using standard FC frame and sequence formats.

**Gigabit interface converter (GBIC)—**A GBIC, also referred to as a Physical Link Module, is a physical component that manages functions of the FC-0 layer. This layer consists of the physical characteristics of the media and interface, including drivers, transceivers, connectors, and cables. A GBIC attaches to an FC adapter and connects a router to an FC host.

**High voltage differential (HVD)—**HVD is a differential SCSI scheme with terminators that run on 5 volts.

**Host bus adapter (HBA)—**An HBA is the critical link between a host server or workstation and a storage subsystem, integrating computing platforms, operating systems, and I/O protocols to ensure proper interoperability and functionality. The bus adapter provides direct storage connectivity from the system to data within the storage subsystem and enables stable, high-speed transmission of information and files. HBAs manage the controller-specific aspects of handling a storage driver interface device implemented as a target driver, which supports mass storage peripheral devices such as disks and tapes. A storage driver interface is used to implement SCSI and other storage device drivers. An HBA connects to the storage subsystem through a single PCI slot in the host computer and uses either fiber or copper media.

**Initiator—**An initiator is an FC or SCSI device that contains application clients that originate service requests and task management functions for processing by a target FC or SCSI device.

**Initiator mode—**Initiator mode is the configuration mode of a device in which an FC or SCSI initiator requests operations to be performed by an FC or SCSI target device.

**Logical unit number or logical unit (LUN)—**A LUN is a subdivision of a SCSI target. For SCSI-3, each SCSI target supports up to 64 LUNs. An FC host using LUNs can address multiple peripheral devices that may share a common controller.

**Loop address—**Loop address is an FC term that indicates the unique ID of a node in FC loop topology. A loop address is sometimes referred to as a Loop ID.

**Low voltage differential (LVD)—**LVD is a method of powering SCSI cables that will be formalized in the SCSI-3 specifications. LVD uses less power than the current differential drive (HVD), is less expensive, and allows for higher speeds such as those of Ultra-2 SCSI. LVD requires 3.3 volts (versus 5 volts for HVD).

**Management Information Base (MIB)—**A MIB is a database of managed objects accessed by network management protocols. An SNMP MIP is a set of parameters that an SNMP management station can query or set in the SNMP agent of a network device (for example, a router).

**Mapping table—**A mapping table is a table indexed by sequential LUN values. The values indicate select bus:target:LUN devices. Mapping tables are used by some routers to perform FC-to-SCSI operations by default.

**Point to Point—**A point-to-point connection is a communication link between two end systems. The point-to-point topology is one of three FC topologies, in which two ports are directly connected by a link; there are no fabric, loop, or switching elements present.

**Router—**A router is a device that enables connectivity between SCSI devices and FC networks. It routes each data command to the appropriate SCSI channel based on the address it is intended for.

**SCSI adapter —**A SCSI adapter is a 16-bit fast/wide differential or 8-bit narrow single-ended physical connection between a router and SCSI devices. Each SCSI adapter supports up to 16 (fast/wide) or 8 (narrow) SCSI devices, including itself.

**SCSI addressing—**Each device supported by a SCSI adapter has its own unique SCSI address, which dictates the device's priority when arbitrating for access to the SCSI bus. A SCSI address of 7 has the highest priority. For a fast/wide SCSI adapter that supports up to 16 devices, the next highest priority address is 6, then 5, 4, 3, 2, 1, 0, 15, 14, 13, 12, 11, 10, 9, and 8. The narrow SCSI adapter supports up to eight devices, including itself. The SCSI address 7 has the highest priority, followed by 6, 5, 4, 3, 2, 1, and 0.

**SCSI bus—**A SCSI bus provides a means of transferring data between SCSI devices. A SCSI bus is either an 8- or 16-bit bus that supports up to 8 or 16 devices, including itself. The bus can consist of any mix of initiators and targets, with the requirement that at least one initiator and one target must be present.

**SCSI device—**A SCSI device is a single unit on a SCSI bus that originates or services SCSI commands. A SCSI device is identified by a unique SCSI address. SCSI devices can act as initiators or targets.

**SCSI port—**A SCSI port is an opening at the back of a router that provides connection between the SCSI adapter and SCSI bus.

**Small computer system interface (SCSI) —**SCSI is an industry standard for connecting peripheral devices and their controllers to an initiator. Storage devices are daisy-chained together and connected to a host adapter. The host adapter provides a shared bus that attached peripherals use to pass data to and from the host system. Examples of devices attached to the adapter include disk drives, CD-ROM discs, optical disks, and tape drives. In theory, any SCSI device can be plugged into any SCSI controller.

**Simple Network Management Protocol (SNMP) —**SNMP is the Internet standard protocol, defined in STD 15, RFC 1157, developed to manage nodes on a Internet Protocol (IP) network.

**Speed—**Speed is a status type in the FC Status Menu that shows the speed (1,063 Mbps) of the FC adapter.

**Storage area network (SAN)—**SAN refers to the network behind servers that links one or more servers to one or more storage systems. Each storage system could be RAID, tape backup, tape library, CD-ROM library, or JBOD. SANs operate with both SCSI and networking (IP) protocols. Servers and workstations use the FC network for shared access to the same storage device or system. Legacy SCSI systems are interfaced using an FC-to-SCSI bridge.

**Target—**A target is a device (peripheral) that responds to an operation requested by an initiator (host system). Although peripherals are generally targets, a peripheral may be required to act temporarily as an initiator for some commands (for example, SCSI COPY command).

**Terminator block/termination—**A terminator block (or termination) refers to the electrical connection at each end of a SCSI bus. The terminator block is composed of a set of resisters, or possibly other components. The function of a terminator block is to provide a pull-up for open collector drivers on the bus, and also impedance matching to prevent signal reflections at the ends of the cable. SCSI buses require that

a terminator be placed on the 68-pin high-density SCSI connector on the last SCSI peripheral. Data errors may occur in a SCSI bus that is not terminated.

**Topology—**A network topology refers to the physical layout of nodes on a network. Topologies range from local network topologies to WAN topologies. FC topologies include point-to-point, FC-AL, and fabric.

**Trap—**In the context of SNMP, a trap is an unsolicited message sent by an agent to a management station. The purpose is to notify the management station of some unusual event.

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Printed in the U.S.
11/00

Document Number: 07-0033-003